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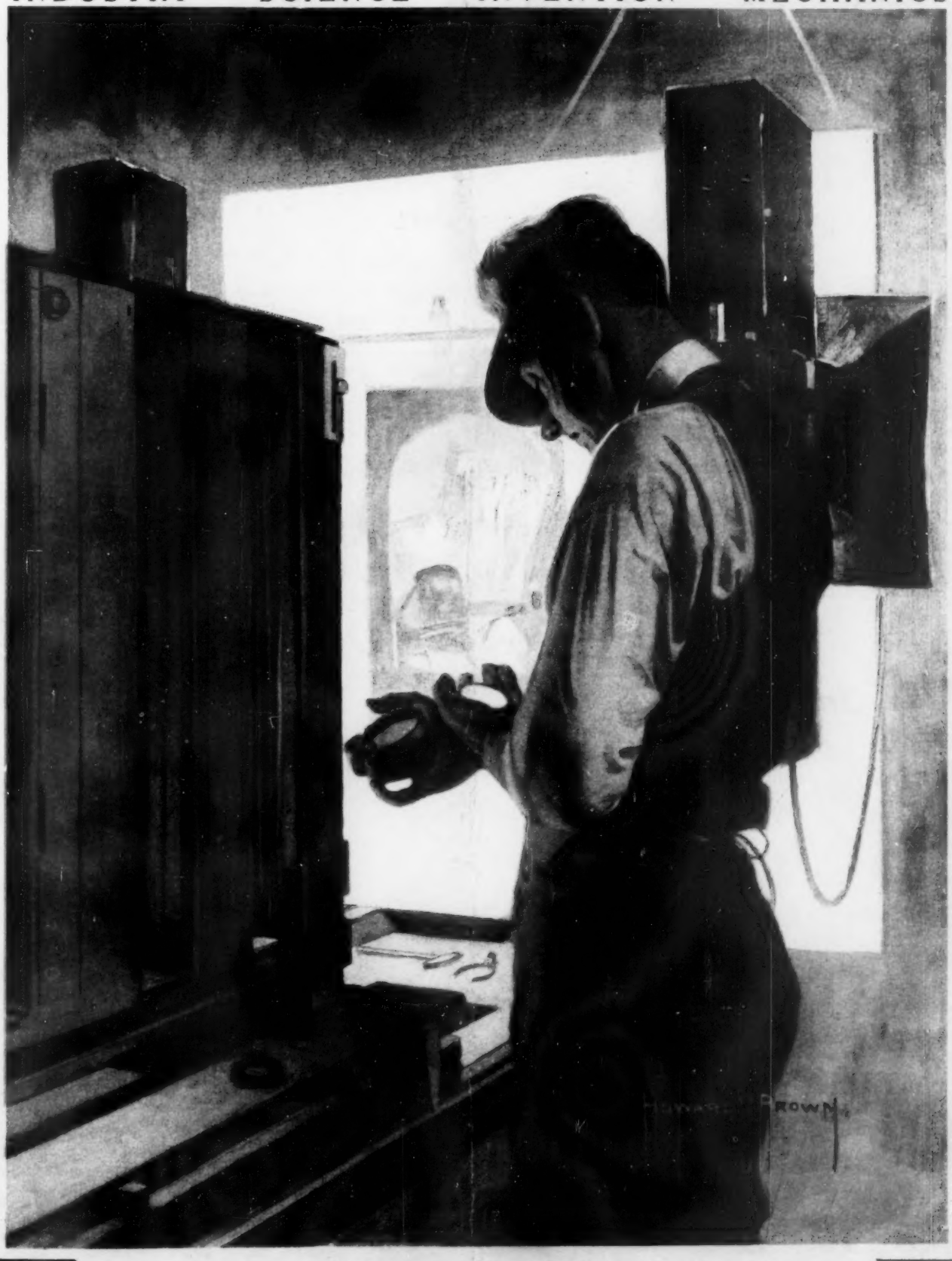
ANNEALING WITH GAS
THE STEAMSHIP PIER PROBLEM

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



OPERATING THE CAMERA IN THE PROCESS OF PHOTO-ENGRAVING.— (See page 493)

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FIRST

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The uses of White Trucks are so varied and widespread that there is literally no transportation undertaking in any line of business in which they have not had a part.

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There are numerous owners' records of 100,000 miles, many of 200,000 miles and some of 300,000 miles.

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White Trucks

Mountains, miles and minutes give way before Electrical Transportation

HIGH up in the Rockies, a giant locomotive speeds across a deep canyon, dashes through a tunnel and glides smoothly along a narrow ledge chiseled from the rocky face of a cliff. No smoke, no dirt—just a steady, powerful display of speed under perfect control, for electricity is the magic power in transportation.

The same force driving mechanisms that are especially built for specific kinds of work, tows ocean liners through the Panama Canal, propels huge battleships, and hauls long trains from one city to another It takes the worker to the city, the farmer to his market, and brings the people of widely separated localities together Electricity in transportation helps to feed and clothe the world, it makes travel better and safer through good light, safe signals, and illuminated highways It helps to develop cities and towns; saves fuel for heat and even increases the usefulness of motor car and aeroplane

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Back of the electric motor, huge hydro-electric generators or steam turbines, large enough to furnish power for an entire state, are connected to long distance transmission lines. Carefully constructed devices for protection, regulation and measurement are provided all along the line.

In all these things, the General Electric Company has co-ordinated the efforts of many scientific, engineering and manufacturing resources to the end that electricity may be a better servant to all mankind

95-169

GENERAL ELECTRIC COMPANY

A "Dead Engine" in the Warehouse District. Many a truck owner is surprised when he learns that 88.4 per cent. of all "accidents" to the average truck can be predicted from its specifications and the parts from which it is assembled

Has the American Business Man Time to Save Money

GENERAL SAM HOUSTON built an empire in the Southwest, simply by doing the *next thing* every day as it came along.

Reconstruction will probably have to be managed pretty much the same way—*producing* with one hand and *saving* with the other, day after day.

The Packard people do not pretend to authority on any subject except *transportation.* But they *can* show the American business man *records of savings in trucking costs*—10 per cent. in gasoline, 18 to 22 per cent. in time, up to 30 per cent. in ton-mile cost.

They can show him, too, how to apply the same methods to *his own business.*

PACKARD has done away with excess costs in gasoline, not only through the remarkable ability of the Packard Truck Engine, but especially by means of the Packard *carbureter.*

Here is a carbureter built especially to stand the vibration of a truck at work. The float feed positive and *precise.* The carbureter water-jacketed and mounted high up on the cylinder *bloc;* so that the gas is warmed by the motor, and fed to the engine ready to flash into power.

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It saves oil again by the *close fitting* of pistons and rings—and by preventing loss of oil through drip.

It saves tires by *distribution of load,* by the positive and uniform action of the clutch—in fact, by the engineering design of the *whole Packard rear end.*

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YOU often hear it said that Americans are too busy *making* money to *save* it.

Yet business men who keep accurate cost figures on Packard, as compared with the average truck, *standardize on Packard.*

"Ask the Man Who Owns One"

PACKARD MOTOR CAR COMPANY, *Detroit*

SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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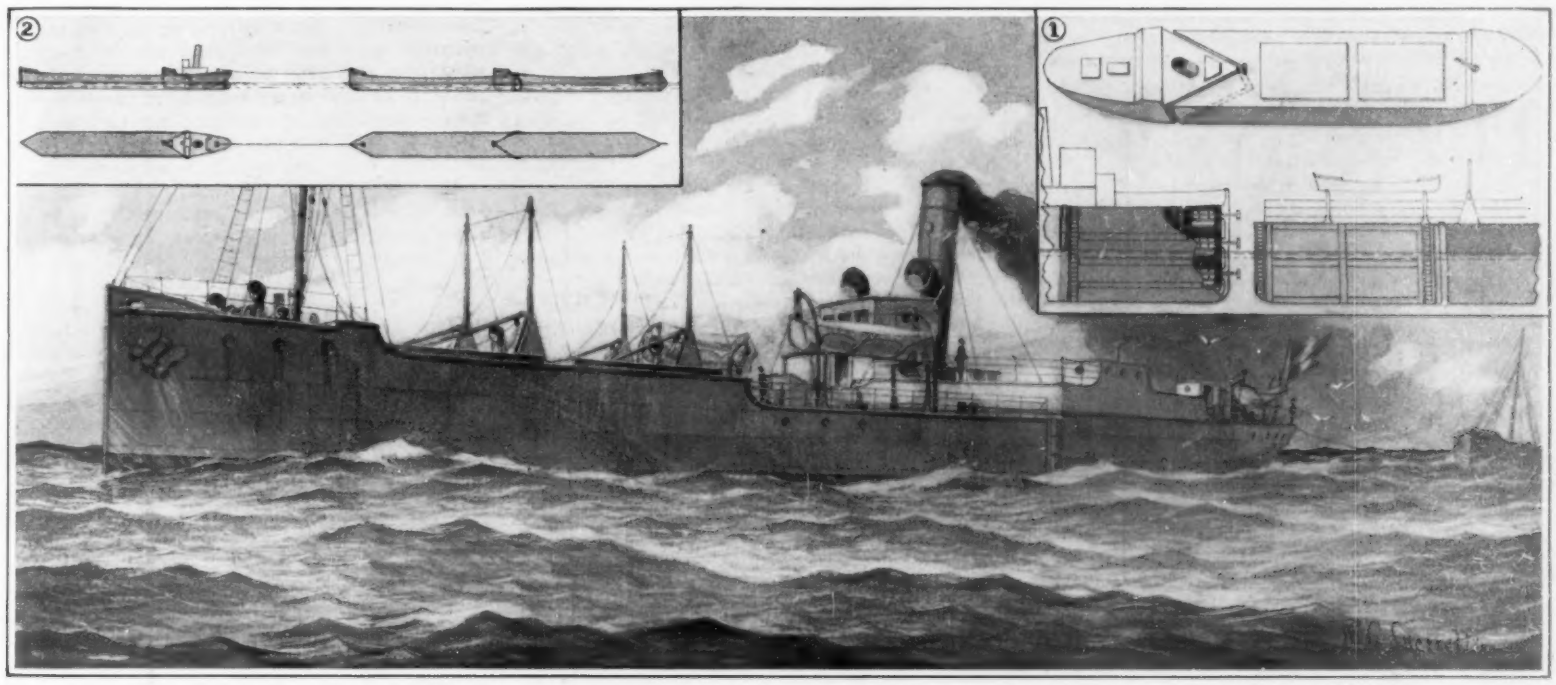

Fig. 1. Illustrating the various essential features of the Constan system and the manner of linking the pusher and the convoy. Fig. 2. Diagram of how Mr. Constan would apply his method to river and canal service

The Constan system of detachable power units for the driving of separate cargo carriers, the main drawing showing how the scheme would apply to sea-going freighters both when propelling a single cargo boat and when towing another laden barge

Can Duplex Craft Speed Up Transportation?

By Robert G. Skerrett

DESPITE the fact that the self-propelled ship of trade has been employed for decades in the profitable transportation of commodities of all sorts, that does not signify that the combined arrangement of drive and cargo-carrying in a single craft is necessarily the most economical. Indeed, such would seem to be anything but the case as analyzed by a well-known French nautical expert, Monsieur Constan. This ex-naval officer has recently devised an ingenious substitute in the form of a detachable power vessel susceptible of being joined successively with freighters especially designed to combine with the so-called "pusher," the two boats when linked having pretty much the outward appearance of an ordinary steamer.

The scarcity of merchant ships has emphasized the need of making the most of the tonnage available, and this is possible only by reducing to a minimum the turn around period during which a boat discharges her incoming goods and loads up for her departure. In self-propelled freighters this commonly means that the power plant in large measure constitutes an unremunerative investment while in port, and its reason for being so is justified only when the craft is underway with paying cargo stored in her hold. Therefore, M. Constan has planned his pusher, as he calls his steamer, so that it will be able to take care of a group of dependent carriers—the number being determined by the route to be covered. The idea is that while the power ship is in transit with a laden craft, another of the group will be loading so as to be ready for departure upon the arrival of the pusher. In this way, the layover period of the automatic unit would be limited to a brief while; and for all practical purposes she would be kept continually active in moving commodities between given ports.

It may be objected that the French scheme is substantially an adaptation of the familiar towboat principle, but we shall see presently that the fact is quite to the contrary, and that M. Constan secures prospectively much more efficient service. He obtains superior seakeeping qualities by uniting displacements of his two sections even though each is self-contained; he does away with the need of a tow line to connect the motive and the dependent parts; and he places the pusher in relation to the cargo carrier so that he can get a maximum of effective propulsive effort. He insures these benefits by giving the after body of the freighter the form of a V in a fore-and-aft direction, and into the opening he fits the wedge-shaped bow of the pusher, where he locks it firmly.

At the apex of the V there is a vertical, rectangular slot reaching from the keel up to the deck. Into this recess are projected from the stem of the pusher three mallet-head keys which, when turned through an angle of 90 degrees, are locked. The shafts upon which these keys are supported, can be moved horizontally by mechanical means, and any motion rearward tends to draw the stem of the steamer more snugly forward against the inner sides of the cargo boat's bifurcated stern. As this wedging might induce spreading of the thinner sections of the V, the designer has provided a locking device on each beam of the pusher by which the aftermost corners of the stern of the carrier are gripped and hydraulically pulled tightly in contact with the hull of the steamer. Vertical motion between the two craft is effectually checked by interlocking horizontal battens, which engage at the forward and after extremities of the V recess.

The designer is confident that the union effected by the several agencies planned will bind the two vessels quite as securely as though they were riveted together. In other words, there will be no play, lateral, vertical or longitudinal, even when driving along in the open sea. M. Constan is convinced that the coupling and uncoupling of the boats can be done in a brief interval, and declares that one vessel can be detached from the other when on a voyage if either be injured fatally—the crew of the sinking unit going aboard the surviving one.

On a long trip, the pusher would draw well-nigh all of her fuel from the bunkers or tanks—depending upon the nature of the fuel—built for that purpose in the two wings of the freighter's stern. In the case of oil, the transfer would be accomplished by suction, and if coal were burned the fuel would be moved from one vessel to the other by a suitable mechanical conveyor. The cargo carrier would be bunkered while taking aboard her merchandise. However, to guard against an emergency, the pusher is assured self-sufficiency by reason of a reserve of fuel which she carries in her hold forward. This supply would also enable the steamer to play the part of a tug in the usual sense of the term during an interval of enforced waiting for her regular convoy. To compensate for changes in displacement caused by the consumption of fuel and the using up of other stores, both the pusher and its attached craft are fitted with water-ballast tanks. Therefore, it will be an easy matter to maintain unison of draft and trim between the boats, and by doing this to obviate any bending stresses which would otherwise be set up if their load lines were not identical.

The virtues of the system proposed by M. Constan are made clear if a given volume of freight is to be moved in a specified time to and from two ports so situated that an unbroken chain of transportation can be maintained by recourse to a fleet of his type. Assuming that two pushers can take care of eight cargo carriers, his figures disclose that for the same service in the ordinary way eight self-propelled steamers of

(Continued on page 498)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

New York's Greatest Handicap

THE natural features which have provided the port of New York with a vast water frontage at which rail and sea traffic may meet, have also imposed a handicap under which New York has suffered acutely. The broad Hudson River cuts the port squarely in two and presents such a serious barrier to all-rail communication between factory, farm and ship, that not only the port itself but a vast section of the United States which is tributary to the port is subjected to heavy expense and intolerable congestion and delay.

Commissioner Robert W. Woolley of the Interstate Commerce Commission, tells us that one of the Commission's ablest examiners recently went into the subject of terminal costs of four cities. At New York, it was found that the expense of handling a car from the time it landed within the terminal limits of Jersey City until it was delivered to its destination in Brooklyn or Manhattan, including lighterage, was approximately $35. At Chicago, where there is a belt line of railway and no lighterage, the cost of handling the same car within the terminal limits was $10.35. At Binghamton, New York, a city of about 60,000 population, the cost was $1.80. These facts were gathered from the reports of the railroads themselves to the Interstate Commerce Commission, and they show that of the total cost of operation, one-third is terminal and two-thirds is due to the line haul.

Now, if it be urged that New York should not be compared in this matter with small cities such as Binghamton, the case of San Francisco, which has municipally-controlled terminals, may be considered. Here we find that against New York's charge of $35 per car, San Francisco has a flat charge of $2.50 per car within the terminal limits. Commenting on these comparisons, Commissioner Woolley goes on to say: "At New York—the terminal sore spot of the nation—the utter injustice of taking care of $35 per car in the line-haul rate—in other words of making the innocent consumer over much of our land stand a tax, that New York may continue to grow and monopolize the export and import business of the country—is impressing many of the big-minded citizens of our metropolis."

To make this matter perfectly clear, it should be explained that when the railroads engage to carry freight from somewhere in the interior to New York, let us say for shipment abroad, the contract includes the whole transit of the freight from the point of origin to the side of the ship. Thus it follows that after computing the rate from, say, Detroit to Jersey City, $35 per car has to be added for getting the car, or its contents, to the pier at which the ship is lying.

But why this excessive cost at New York?

It is due to the fact that whereas at the other leading ports of the world the carload of freight can be carried out onto a pier alongside the ship and discharged directly to the hull, in New York, because of the barrier presented by the Hudson and the East Rivers, the freight cannot be thus directly discharged, but has to be loaded onto lighters and towed, often many miles, before reaching the pier at which the ship is loading. This system of lighterage is costly and time-consuming and is at all times liable to be interrupted by strikes or by the ice of a severe winter such as that of 1918.

The remedy, of course, is obvious. We should do what Chicago and other great cities have done—build a belt line, with tunnels or bridges across the Hudson River and East River, which would at once connect up every trunk railroad that enters the city, break up the present congestion, and render our freight traffic so fluid, that a car coming in on any one of a dozen roads, whether by way of New Jersey, New York or Long Island, would move intact to any pier throughout the whole sweep of our water front from Perth Amboy to South Brooklyn—including, of course, the whole waterfront at Manhattan.

The present lighterage system is doomed, and this for two reasons: first because of the present congestion and its resulting delays—evils which will be greatly aggravated by the enormous growth of our merchant marine—and secondly, because the shippers all over the United States are beginning to grumble at having to pay $35 a car as the price of our antiquated terminal system. Federal action may be looked for in the near future which will cut the terminal charges from the rail rate and throw this added burden upon the city of New York. As a matter of fact, the Federal Government is beginning to take serious cognizance of the situation at this port, and there is a clause in the recent railroad law, bearing rather directly on this question, which should give the port authorities of this city cause for much serious thought.

We have shown elsewhere in this issue how closely the present inadequate dock system, with its narrow piers, is related to the absence of proper terminal rail facilities. If the port of New York is to be developed on modern lines and take rank in its freight-handling facilities with the other great ports of the world, a drastic change must be made at once in our railway facilities. We believe that this can satisfactorily be accomplished only by close coöperation of the New York and New Jersey Harbor Improvement Commission with the Federal Government.

A Matter of Common Sense

OUR correspondence page this week carries an example of ignorance on the part of one who should be reasonably well informed on topics of general information—an example which, as the man points out who brings it to our attention, is by all means one of the most horrible things of the sort that could well be imagined. When we first read the clipping in question, we could not believe it genuine—we suspected that some bright little practical joker was having his fling at the speaker for presenting such a subject on such an occasion. But on second thought, when we realized how easy it was, by changing a word here and inverting a phrase there, to reconstruct from this puddle of balderdash the actual speech of the gentleman who was thus misrepresented, we decided that the gem was what it purported to be—an honest effort of some over-ambitious and under-informed cub reporter to reproduce what he thought he had heard on a subject that meant absolutely nothing to him.

Taking this for granted, we want to moralize a bit on the text which is thus presented. It is perhaps not surprising that a person who can read and write should, in this era of enlightenment, have escaped contact with the fundamental facts of the universe. To be sure it seems as though anyone who is at all literate should have had it brought to his attention that the earth rotates on its axis and revolves around the sun; that 24 times 1,000 equals 24,000; that the sun, with respect to the earth, is fixed in space; that space is measured in miles, and not in miles per year; that the earth is not a "lighted body," unless this phrase is to be interpreted as "lighted by the sun," in which event the other planets are likewise lighted bodies; that if the earth were placed in the center of a hollow sun it could rotate at a given distance from the sun's surface only if that distance were the one determined by the given conditions, and that in this event there couldn't be 200,000 miles or 200,000 inches "left over"; and even that 100 light-years, instead of being a large astronomical quantity, is a tolerably small one. But our modern scheme of economics is such that nobody is under any compulsion to know these things unless he wants to—he can make a decent living, he can even exist in luxury, without knowing that the earth is round and that the luminaries of day and night do not move in the way that appearances would indicate. We may even argue that it is entirely respectable for a person to devote so much of his time to the things that do matter in his daily life that he has no time left to give to the things that do not so matter.

But it is neither credible nor respectable to discover that such an outrageous perversion of facts and common sense can be written by a reporter, get past his superiors, and run the gamut of the linotype and the proof-reader and the make-up man without meeting a single soul who is competent to expose it. The thing happened in a rather small and out-of-the-way town—we wonder whether it might not just as easily have happened in a bigger and more prominent place? To just what extent are we to conclude that people who cannot receive and hold the spoken word any more accurately than this reporter has done are occupying places where they must act on the spoken word? To just what extent are we to suppose that there are at large in the community, people occupying responsible places, on whose statements we must more or less depend, and who can make such statements as the one about the sun and the earth and the moon, or the one about a hundred and fifty million miles a year, without automatically realizing that these statements simply do not make sense? To what extent do the Albuquerque reporter and compositor and reader represent the standard product of our modern school system? If anybody can give us an encouraging answer to these queries, we should be greatly heartened to have him do so. If the human race is really traveling in the direction indicated by this incident—toward the achievement of an infinitesimally thin upper crust of Ph. D.'s who know everything and a residual general mass who know nothing and are utterly lacking in intelligence as well as in information—if this is a justifiable conclusion, we think that the sooner it is generally recognized the better it will be for all concerned.

The Peril of the Straight-Stem Ship

WE have become so much accustomed to seeing the straight stem on merchant shipping that the presence of the old, curved, clipper stem on a steamship, unless she should chance to be a yacht, has come to stand as the mark of a ripe old age. And yet, if the advice of Captain H. F. Young, of the Board of Trade, given at an annual dinner of British shipmasters be followed, we may yet see a return, if not to the curved clipper bow, at least to a stem inclined forward at fifteen to twenty degrees. The object of the change, as recommended by this Board of Trade official, would be humanitarian; for he believes, and we fully agree with him, that the change would result in the saving of thousands of lives. In the event of collision, the straight stem means that the stricken vessel will be pierced below the water line. But if the ship that strikes has a forward-inclined stem, the blow will be taken first by the upper works and topsides and, in the majority of cases, the momentum of the striking ship will be absorbed before the rent has extended down to the water line. It is stated that several leading steamship companies are already adopting these suggestions. We are not sure that anything will be lost on the score of appearance. The fast cruisers built by the British during the war have the inclined stem and, if anything, it adds a touch of smartness to the appearance of the vessel. The White Star liners have always had a slightly inclined stem. It is quite conceivable that, once introduced, it will rapidly become popular.

Nor is the protective effect of the inclined stem limited to a ship that is rammed. In many, if not in the majority, of collisions, the crumpling up or twisting aside of the inclined bow, will not extend below the waterline, and the chances of the ship reaching port will be measurably increased. Furthermore, there is a tendency, just now, to follow the lead of naval constructors in the matter of providing wide, flaring bows to assist a fast ship in driving through head seas. A bow of this character would absorb more of the energy of collision than the old wedge bow, and the chances of damage would be proportionately reduced.

Electricity

Lamp Filaments and High Voltage Conductors.—In a number of the modern substations of a power company of southern California, annoyance was caused by the breaking of filaments in incandescent lamps which were installed near the high-voltage conductors. The trouble was caused by the alternating magnetic field maintaining continuous vibration of the filament. Since it was advisable to have the lamps placed near the high-voltage conductors in order to have the light where it was needed, it was necessary to replace the usual tungsten lamps with the gas-filled type provided with more rugged filaments.

Japanese Naval Radio Expansion.—It has been reported that the estimates for radio expansion in the Japanese budget for the coming year do not cover the overhauling of the Funabashi station, which must soon be done, as the apparatus is of the old German one-mast type, but only provides for the replacement of the sending and receiving outfits. This is one of the three stations belonging to the Japanese Navy, the others being Hozan (Formosa) and the station at Sasebo, now in course of construction. It is anticipated that the navy will present a supplementary estimate to cover the construction and repair program considered necessary.

Multiplex Radio Telephony.—Two radio telephone conversations through a single antenna a distance of five miles was the accomplishment reported by F. M. Ryan, J. R. Tolmie and Roy O. Bach at the recent meeting of the Institute of Radio Engineers. The paper was read by Mr. Ryan, who is engaged in extensive radio research work. This authority states that as many as five telegraph messages were being sent or received simultaneously with a single antenna, and that as many telephone conversations could have been carried on had there been sufficient apparatus at hand. The method used was that of a number of radio frequencies with a series antenna circuit. The calculations of the circuit were also shown.

Dry-Cell Voltage and Hydrogen-Ion Concentration.—United States Department of Commerce, Bureau of Standards, has issued scientific paper No. 364 on "Relation of Voltage of Dry Cells to Hydrogen-Ion Concentration," by H. D. Holler and L. M. Ritchie. The paper tells that the potentials of electrodes consisting of Acheson graphite and certain manganese ores were found to be a logarithmic function of the hydrogen-ion concentration of the solution in contact with the electrode, while that of electrodes containing a chemically prepared oxide of manganese is independent of hydrogen-ion concentration. The relation between the potential of the manganese dioxide electrode and hydro-ion concentration explains variations in open-circuit voltages of dry cells and accounts for the polarization of a dry cell on discharge. Those interested can obtain copies of the paper by writing to the Bureau of Standards, Department of Commerce, Washington, D. C.

Thermostatic Metal.—It is said that until recently German-made thermostats had some advantages over those of American makes, especially in that they developed a duplex metal with an absolutely homogeneous joint, the two metals being alloyed at the junction point so that no movement of the metals was possible. Recently, however, thermostats have been devised in this country which are fused at the junction point and offer a deflection per degree 18 to 20 per cent greater than that of the foreign product. The characteristics of this thermostat as deduced from careful laboratory tests are, thanks to the *General Electric Review*, given in brief as follows: (1) Deflection upon temperature change varies inversely as the thickness, varies as the square of the length, is not affected by changes of width and varies directly with degree temperature change. (2) Force exerted upon temperature change varies as the square of the thickness, is not affected by change in length, varies directly as the width and as the square of the degree temperature change. (3) Weight required for permanent set varies as the square of the thickness (between narrow limits), inversely as the length and directly as the width.

Science

Total Lunar Eclipse May 2nd.—Since "The Heavens for May" is unavoidably postponed until the following issue, we take this opportunity of telling our readers that on the evening of Sunday the 2nd they will have a chance to see the full moon in total darkness. The moon enters the penumbra at 5:49 P. M., enters the umbra at 7:01, and becomes completely eclipsed at about 8:13. The middle of totality is set for 8:50, its end for 9:27; the moon is clear of the umbra at 10:41, and of the penumbra at 11:50. All these hours are in Eastern Standard Time, and must be appropriately modified in other sections of the country, or where daylight saving is in effect. It is suggested that Mars is close enough to the eclipsed moon to serve as a rough basis of estimating the brightness of the latter.

Arctic Explorations by Airplane.—An elaborate campaign of exploration in the Arctic regions by airplanes has been under discussion in Germany for a year past. It is proposed to establish the principal base on the west coast of Spitsbergen, and to use a considerable number of airplanes, always flying in pairs. Relatively slow machines of large carrying capacity would be used for laying out depots and marking routes, while lighter and faster machines would be used for explorations.

West African Time.—A new complication in time-keeping is reported for the British Gold Coast colony, West Africa. According to a recent enactment, Greenwich mean time is to be used hereafter from January to August, while during the rest of the year civil time will be 20 minutes in advance of Greenwich time. The object of this innovation is said to be to take account of the equation of time and adopt a schedule of time-keeping more closely approaching that of the natural, as distinguished from the fictitious, sun; an advantage in a colony where clocks are few.

Mosquito Larva Killed by Foul Water.—One surprising result of some recent investigations of the Public Health Service on the food of *Anopheles* larvæ is that these larvæ do not, as popularly supposed, thrive in foul, stagnant water. In laboratory experiments it was found that when cultures containing large amounts of decomposing vegetation were introduced and kept without sterilization or aeration, the larvæ usually lost vigor and died in a few days. Whether the injurious effects of decomposition are due directly to bacterial or protozoal action on the larvæ themselves, or indirectly to an excess of CO_2 or other gases resulting from the decomposition is not certain. Apparently the purer and more sterile the waters may be, so long as they contain sufficient food, the more suitable they are for *Anopheles* breeding. Hence there is danger of doing more harm than good by cleaning the refuse from stagnant waters to get rid of mosquitoes, unless provision is made for subsequent drainage, oiling, fish control, or some other method of mosquito eradication.

The Singing Sands of Lake Michigan are discussed in *Science* by Mr. W. D. Richardson, who advances a new hypothesis on the subject. The sands in question are found everywhere near the water's edge throughout the dune region, which borders nearly the whole eastern side of the lake from Gary to Mackinac. The characteristic sound is heard when one walks in the sand or pushes a stick or other object through it, but only when the sand is dry. The sound-producing sands only extend back from the water as far as the line of driftwood, indicating the boundary reached by waves during storms; beyond this limit sand having exactly the same appearance, microscopic as well as macroscopic, produces no sound. The writer suggests that periodical wetting by the water of the lake deposits a thin film of salts, including calcium and magnesium carbonates, upon the grains of sand. This film creates considerable friction when the grains are rubbed together and thus causes the sound, the effect being similar to that of rosin on a violin bow. When the sand is carried farther inland by the wind to form the dunes, much of the salt film is rubbed off, and leaching by rain subsequently completes its removal; hence the sands cease to be "musical."

Aeronautical

What Next?—From Santa Barbara, California, comes word that a horse entered in an exposition held in that city arrived by airplane from Los Angeles. The trip was delayed a day until officers of the Humane Society were fully convinced that no cruelty was involved in the trip.

Licensed Pilots of France.—The total of airplane pilots' certificates issued in France now stands at 15,576 of which 1,732 were issued in 1919. The number of airship pilots' certificates totals 43, of which 12 are dated 1919, while balloon pilots number 448, but only three qualified last year.

Woman Flies to Morocco.—A French aviatrix has arrived at Rabat, Morocco, from Paris by air, having made the flight in two days. This is the first case of a woman flying from France to Morocco. Her route was via Toulon, Barcelona, Valencia, Alicante, Granada, Malaga and Tangier. The distance covered was about 1,150 miles.

Air Routes for India.—The officers of the Royal Air Force who have been deputed to undertake the preliminary survey for the chain of air routes that is eventually to connect all the chief commercial and industrial centers of India, have covered much ground in the past three months, according to an issue of *Commerce*, and have selected several landing stations, in addition to a site near St. Thomas Mount, Madras, which seems especially well adapted to the requirements of the aviator.

Anti-Airplane Curtain.—Lecturing recently before the Royal United Service Institution, Flight-Lieut. F. Worthington, R. A. F., stated that to raise a curtain of wires against the enemy aircraft in the London barrage a captive balloon was devised which carried the wires to 15,000 feet. It caused one Gotha to come to grief. Great stress had been laid on the danger of an unannounced attack on London by hostile aircraft; and he suggested that a suitably organized "apron" scheme afforded the cheapest and readiest insurance against this danger.

Universities in Air Race.—According to plans made some time ago, six universities at least are to compete in the first intercollegiate air race of history for the American Flying Club Trophy on May 6th and 7th. The course is 550 miles, and the event formally adds aviation to the list of college sporting events. Representatives of Yale, Harvard, Columbia, Princeton, Williams and Cornell have been perfecting arrangements and, with the assistance of the officials of the the American Flying Club Trophy on May 6th and 7th. erning body under the title of the Intercollegiate Flying Association.

Japanese Airplane Engines.—Nagoya is destined to become the center of Japanese aviation, according to a translation from the *Osaka Mainichi Shimbun*. The army machine works, now under construction at Chikusa, a suburb of Nagoya, will be partially completed and in operation, it is expected, by the beginning of this month, at which time the Atsuta airplane factory will be removed to the same place. In this factory seven powerful motors of the Salmson type are under construction, which, while nominally of 230 horse-power, actually develop 250 horse-power. The material used is wholly Japanese, and the results of tests are reported to be most satisfactory.

Aero Stamps.—The advent of the flying postman, and the development of the aerial mail, have brought a new and fascinating interest into the stamp-collecting hobby. Mr. Fred J. Melville, the president of the Junior Philatelic Society, has just compiled the first detailed catalogue of aero stamps. It enumerates all the special postage stamps issued up to date for use in franking letters for transmission by air post. It is interesting to note how many different countries figure in the list. There are aero stamps from Austria, Canada, Colombia, Germany, Hungary, Italy, Japan, Newfoundland, Switzerland, Tunis, and United States. All the stamps, including the historic "Hawker" and "Alcock" stamps of the Transatlantic flight are illustrated. The booklet is published at 6d. by the Philatelic Institute, 110, Strand, where there is practically a complete collection of the rarest air stamps at present on exhibition.

The Ingenuity of the Watchmaker

Some of the Methods and Tools That Make This Trade Rank as a Profession

By Robert F. Nattan

ONE can learn to take an automobile engine apart and put it together again properly in three months, and even in less time than that by intensive training. But not so with a watch. Few of us who look at our little timepieces every day think of the remarkable patience and ingenuity required by the skilled watchmaker. Unlike the machinist in other lines, he must work largely with a magnifying glass in order to see the minute parts of the watch. If he is a real watchmaker and not a tinker, he must understand a good deal about the theory and practice of horology. Strange as it may seem, we do not in this country emphasize horological education as is done in England, Switzerland and France. As much attention is devoted to horology abroad as to law or medicine in this country, and sometimes even more.

Here in America we have but few men who might be termed expert horologists. Even efficient watch repairers are becoming scarcer every year, although nowadays splendid opportunities are offered to capable men. Salaries range from forty to sixty dollars and even more per week. The watch repairer who, some years ago, had to act as engraver, optician, salesman and general major domo is at last coming into his own. For crippled soldiers desiring a sedentary occupation the field is particularly inviting, the only objection being the length of time necessary to master the science, which is at least two years. It is worth the effort, however; for besides affording a congenial means of livelihood, the watch repairer's training opens up numerous other opportunities in the machine world. Most of the repairers of the altimeters used on airplanes during the war were watchmakers.

The efficient watch repairer must know something about higher mathematics, possess a peculiar sensitiveness of touch in his deft fingers, and have a resourceful and inventive turn of mind in order to meet the many snags that frequently arise in his work. Many of the so-called complicated watches evince marvelous mechanical and horological genius. It is interesting to note here that the mechanical world is indebted to the watchmaker for the scientific method of making rifle bores. The revolving gun is fed up to a reamer, which follows the center of motion; and thus marvelous accuracy is insured. Watchmakers of the old school and even many today who do not possess an American lathe turn holes in a staff in which to insert a pivot in exactly the same way, drawing the old-fashioned bow across the small pulley-wheel in the little pivot drilling tool illustrated herewith.

Watchmakers are obliged to handle a great deal of their work with special tools which they must make themselves. Women's wrist watches, which are so popular now, are perhaps the most trying of all on the eyes and nerves of the repair man. The parts of these watches are so small that it requires the patience of a Job to do the work as it should be done. Most watch parts, as mentioned before, are repaired under a magnifying glass, being handled with pliers, tweezers, holders, etc., in order to operate conveniently and without damage. The watchmakers' tools are indeed unique and numerous, owing to the multiplicity of operations required. Some important ones are illustrated.

No wise man will for a moment tamper with his own watch when it gets out of order, for there are few other machines that can be put so easily out of adjustment. Perhaps the commonest causes of defective time-keeping or total stoppage in a watch are worn pivots, broken jewels, broken mainsprings, broken winding mechanism, wheels out of round, defective adjustment of the balance, broken roller jewel, worn pallets, congealed oil, or oil containing acid. Mainsprings frequently break in very good watches, but this does not argue against the workmanship of the watch; for it has been proven that these breakages are often caused by electric storms, thunder showers, etc. Watchmakers are called upon to replace more mainsprings in certain seasons of the year—in the early fall, for instance. When such replacement is necessary, the first consideration is to select a suitable spring.

Mainspring gages are now made by which the watchmaker can measure the old spring and thus order a new one with assurance that it will fit. The interchangeability of parts which so characterizes American watches, it should be said here, has of course greatly facilitated their repair.

When the repairer secures his mainspring, he has a special tool known as a mainspring winder for winding it up into its proper form and then forcing it within the mainspring barrel of the watch, where it belongs. When a mainspring has to be inserted in a watch, one of the mainspring winder barrels should be selected that will just fit into the mainspring barrel of the watch. The watch tinker will twist the mainspring into the barrel with his fingers—a most inaccurate operation. It is interesting here to note that an attempt was made some time ago to compel watchmakers in Wisconsin to undergo an examination before being allowed to practice their trade. Inaccurate time has caused many railroad disasters.

For punching holes in the mainsprings, a mainspring punch is used. The tool illustrated has five different styles of punches for different styles of mainsprings. This tool may also be used for punching a new tongue in the edge of the barrel to engage what is known as a slip-end spring. The punches are not only of various sizes, but of different shapes also—round, square or oblong; and the tool of course can be used not alone for making holes of various sizes and shapes in mainsprings, but in thin metal for other purposes.

There are various methods of attaching the spring to the barrel. Its end may be a T-end, fitting into small holes bored in the barrel. In cheap watches the spring is simply bent back to form a tongue, and this style is known as a slip-end. The slip-end rests against a tongue formed in the barrel. In many fine watches the end of the spring simply has a hole punched in it, and fits over a plug screwed in the end of the barrel. Or this style is often used with a plug on the end of the spring and a hole punched in the barrel.

Where very great accuracy is required in measurements such as the diameters of pivots or pinions, the thicknesses of plates, etc., a micrometer or a douxieme gage is the reliable tool. The short end of the douxieme gage, as seen in the illustration, terminates in two jaws which embrace the work to be gaged. Fixed to the long end of one of the limbs is the scale, and the long end of the other side ends in a pointer, so that the size of any object in the jaws is exaggerated on the scale. The name douxieme gage applies only to those instruments that register twelfths of a line, or 144ths of an inch. In some gages the inch is divided into tenths and hundredths, and in other cases the millimeter is used.

In fitting a new balance staff into a watch, a number of different tools is required. A small thin-bladed implement is used to remove the hair-spring and collet from the staff (the axis). Then the roller-table may be removed with what is known as a roller remover, although there is also obtainable a staking tool which is provided with stumps and punchers for the same purpose. The roller remover is operated by placing the foller into the hollow end of the device and then pressing down the lever. Thus the roller is forced out. This part of the balance designated as the roller is a little disk on the arm of the balance wheel, and contains what is known as a roller jewel, usually made of sapphire or ruby. This latter gives the impulse to the fork, which forms part of the escapement of the watch. The escape wheel of the watch is sometimes called the fifth wheel. The staking tool before mentioned is really considered the best to use for removing rollers and is a very necessary tool for the watchmaker, as it is used for removing the old balance staffs, restaking them in the balance, and for rivetting. When a new staff has been selected and properly fitted to the jewels, it is placed in the proper hole in the die of the staking tool, then a suitable puncher is selected and the staff is quickly riveted or staked into the balance.

After the staff has been securely staked in the balance, the balance-truing calliper is used to "true" the balance in the round and also in the flat. When a balance has been fitted with a new staff, it is essential that it be made to run perfectly true. Otherwise a close rate cannot be obtained from the watch. Much skill and patience are required to true a balance properly, and the work is invariably done under a magnifying glass.

The roller-table is staked on the staff after the balance is properly trued and the balance is then ready for "poising." In order that the watch may run accurately in different positions, it is essential that the weight of the balance rim be evenly distributed. This condition is attained by placing the balance on the knife-edge planes of the poising tool. The heavier part of the balance naturally swings downward. The watchmaker secures the proper distribution of weight by removing a small amount of metal from the slot of a tiny screw in the balance rim, or by adding to these screws wee washers, generally of gold, platinum or copper. As the specific gravity of these metals varies, the particular metal used depends upon the exact amount of added weight required. The skillful watchmaker with his sensitive fingers is able to tell which metal to employ. When a balance is carefully poised it will rotate freely.

A roller-jewel setter and a pallet-jewel setter are two very necessary tools. The former may be easily made by a watchmaker by bending a piece of brass wire into the form of an elongated "U" and then shaping the ends to fit over the roller-table. In use, the end of the loop is held over a flame, a small amount of gum shellac is applied to the jewel hole, and the jewel set in place.

If we look in our watch, just near the balance, we shall see, at either end of the fork that plays into the escape wheel, two little stones. These may be of sapphire, ruby or other hard stones. As we watch them they seem to strike the escape wheel. These are known as pallets and sometimes become loose; the tool known as the pallet-jewel setter then comes into play. The pallets are put on this device, which is then placed over a flame. Cement is put on each side of the pallet stones, which in this way become cemented into position.

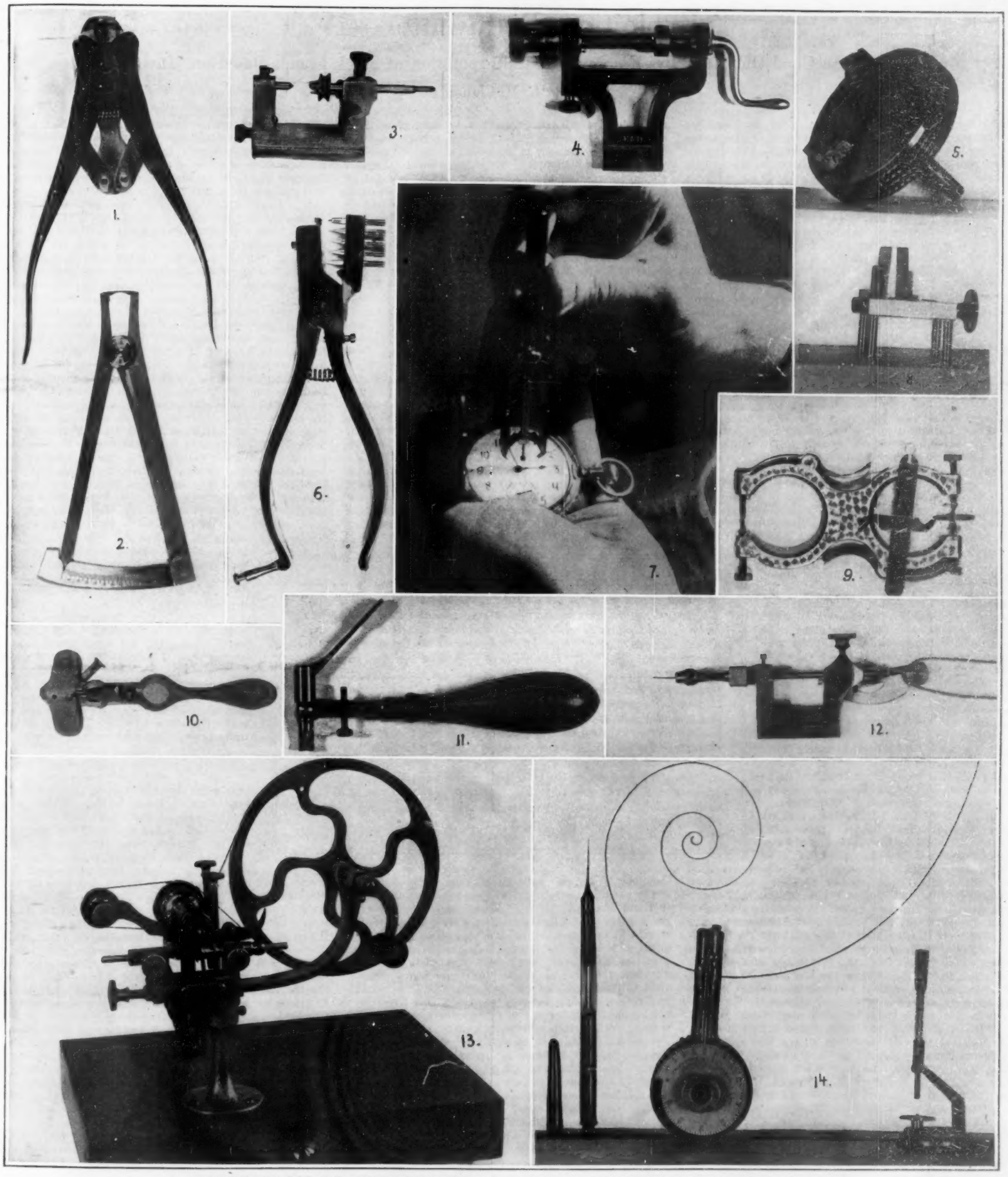
In fitting a new crystal into a watch bezel, the watchmaker often finds bezels which are badly nicked and bent out of shape. Then he must turn a new curve for the crystal and for this purpose a bezel chuck is required. This bezel chuck is also used for a number of other operations, such as holding a watch plate for recessing, turning, etc. Then, too, the ring or bow on one's watch comes loose and often falls out; and probably the majority of watch owners have convinced themselves by trial that when this happens the offending member cannot be replaced by unskilled labor without damaging it. The watchmaker does the trick by aid of the odd-looking plyers known as the pendant bow and ring bender, with which he tightens the ring again into its position.

The watchmaker has a very bizarre little device for removing the hands from a watch. The two jaws at the lower end of the tool clutch the center of the hand, the top of the handle of the tool is pressed down, and the hands come readily off.

Some workers put the hair-spring on the balance with pliers, but in this way they are apt to scratch or scrape the little cap, known as the collet. To avoid this trouble a watchmaker named Gilstad invented an ingenious little contraption that operates somewhat as does the staking tool. The balance is placed on a little plate containing two holes, one for the pivot and one for the roller jewel. The handle of the tool, containing the little spring, is forced down on the balance and the hair spring is thus firmly put in its place.

(*Continued on page 498*)

GIVEN wrenches, hammer and screw-driver, plus a little mechanical horse-sense, it is not a difficult problem to master the construction of any ordinary machine to the point where it can be dismantled and set up again. But wrenches and hammer and screw-driver of the conventional sort are of little avail in handling the tiny intricate parts of a watch —nor does even mechanical ability alone get one very far in this direction. A very special variety of skill and knowledge is required; and on top of that one must have a supply of what the general mechanic would characterize as altogether extraordinary tools. What some of these special implements of the watchmaker's craft look like and what they are designed to do is shown and told in this article and the photographs on the opposite page.—THE EDITOR.



A COLLECTION OF CURIOUS TOOLS FROM A WATCHMAKER'S BENCH

1. Pendant bow and ring bender, for closing the watch bow or ring back into place after it has become loose and dropped out. Patent watch-rings that will not open are eliminating this particular tool from the active list. 2. Douxieme gage for measuring small pivots, pinions, thin plates, etc.; its scale is divided into 144ths of an inch. 3. Hand device for drilling pivot holes. 4. Mainspring winder, for winding up a mainspring prior to inserting it in its place in the barrel. 5. Bezel chuck for cutting or opening up the groove in which the crystal fits. 6. Mainspring punch for making new holes in a mainspring after the old ones "tear out." 7. Claw-like device for removing the hands of a watch. 8. Balance-poising tool, used to determine whether the distribution of weight in the balance wheel is even. 9. Calipers for truing balances and wheels. 10. Pallet-jewel setter for dealing with loose or broken jewels of this type. 11. Roller remover, for removing the roller from the balance staff. The hollow end of the tool is placed over the roller and the lever pressed. 12. Lathe tool for enlarging roller-jewel holes, an extremely delicate operation. 13. Rounding-up tool for shaping the teeth in train wheels or for slightly reducing the diameters of their pitch circles in order that they may mesh better. 14. The fountain-pen-like device at the left is a jewel gage; in the center is a mainspring gage, and at the right a device improvised for putting a hairspring on the balance.

Exploiting the Inventor—IV

A Few of the Good Old Stand-Bys Employed in the Promotion of Stock Frauds Based on "Inventions"

By C. H. Claudy

THE mechanical inventions, real or imagined, of which we spoke in the third article of this series are not the only kind by means of which the wily promoter enriches himself at the expense of the citizen whose thoughts turn to investment but whose instincts are not those of self-protection. For one thing, even though the artificial fuel scheme is getting a bit shop-worn and *passé*, we may expect to see stock sold in a few more briquette-making machines before the public as a whole classifies such propositions definitely with the green-goods game and the gold-brick swindle, and stops falling for this particular appeal. "Artificial fuel" is always made from coal dust, which is actually a drug on the market, as the promoter represents it. It will not burn for the very good reason that it is so light that the moment the draft is put on, the dust flies out the chimney before it is possible for it to ignite. Accordingly, it is an inventor's dream of long standing to put this dust together, by means of some sort of binder, into a cake or brick that will stay in the furnace while the flame consumes it. The trouble with almost all the binders is that they are so expensive that the briquetted fuel costs more than coal, or else that they are themselves non-combustible and present in such volume as to interfere with proper burning of the coal, or finally that they melt so easily that, before it can ignite, the coal returns to dust or is converted into a doughy mass which will not burn.

It is of course easy enough to "invent" a briquetting machine. It is just as easy to employ an expensive bituminous binder and call it something else—molasses or glue or sludge or "secret chemical compound." The public sees dust and liquid go in one end of the machine and perfectly good fuel come out from the other end. Naturally the public buys shares in the company that controls this marvelous process—but never stops to verify that the materials are really what they are said to be. It makes a slight difference in the commercial success of such a process whether a ton of briquettes calls for 20 gallons of binder at five cents a gallon or at sixty cents. Either is valid for demonstration purposes by the shifty share-seller; but marketing the product at a profit is something else.

It seems not altogether impossible that chemistry, or electrochemistry, may some day make it possible to manufacture gold out of some far less valuable substance. The ultimate realization of "The Doings of Raffles Haw," an admirable tale of a man who discovers how to transmute metal into metal by increasing the atomic weight, is foreshadowed in the latest discoveries of science, which seem to indicate that all matter has a common basis in the form of electrical energy or motion. The present scribe, for one, would not care to venture a prediction that no such discovery will ever be made. But he does venture to predict that when and if it ever is made, its discoverer will not make it public. Any man with brains enough to learn how to make gold out of lead will not sell stock in the machine or the process. He will not if he can help it allow it to be suspected that gold is being made out of lead—for of course if this were known or suspected the value of gold would take a big slump. He will just make and use the gold—as did Raffles Haw. Moissan has shown how diamonds can be manufactured, and has made them. True, his diamonds are small, and cost a lot more than those that are dug from the ground. Indeed, if this were not the case, if Moissan had discovered a way to make large and salable diamonds inexpensively, he could have sold his invention for his own figure to the diamond-mine owners, who would otherwise have had to go out of business. He would surely not have been reduced to hawking it about by cheap stock-selling methods. And a man who had discovered how to make gold could similarly, by dealing with governments or big men, if he did not care to operate himself on the quiet, realize far more than by peddling stock in his "invention." Yet we find continually schemes being sprung on the public, if not how to make gold, at least how to make other things, from whiskey to gasoline, which are supposed to represent fortunes.

Unfortunately for the investing public, a lot of "substitute" discoveries *have* made a lot of money. The mercerizing process by which cotton becomes as silk, the newer methods for making cotton look and act like wool, are cases in point. Even pulp paper is a substitute for rag paper. There are materials which look like leather and in service are better than leather. Why not, then, a material which looks like rubber and is better than rubber? Why not something that looks like sugar and is better than sugar?

But there is a great big "Beware" sign staring the cautious in the face, in all such cases. First: can the material *really* be manufactured more cheaply than the thing for which it is to be substituted? Second: does it *really* do the things claimed, and *really* take the place of the thing for which it is substituted? Third: *who* are the men behind the company? Are they well-known business men, men of honorable reputations; or are they just John Smiths and John Does and Richard Roes whom no one knows or has heard of?

If you saw an announcement in the paper that the Rubberless Tire Company has acquired the wonderful patents of John Jones for the making of substitute rubber, and offers the Jones tire at one-half the price of standard rubber tires, would you go straightway out and reshoe your car? Probably not. But if Goodrich or Goodyear or United States Rubber came out with a similar announcement, you'd investigate in a hurry. You would know that great reputations, carefully built up, with splendid material and great expense, were not going to be played with unless there was something back of the new play. If Henry Ford or the Packard Company came out with an announcement of a car which used a mixture of water and kitchen refuse as fuel and which ran as well as one employing gasoline, you'd surely not end the matter with a laugh of disbelief. If the Steel Corporation should discover a new metal of half the weight and half the price and twice the strength of steel, you'd believe it when they said so. But the general public, for some weird reason, often believes statements like this when made by wholly irresponsible people, merely because these irresponsible people insist loudly that they are eminently and entirely responsible. "Our Mr. John Johnson, the well-known banker of New York," sounds perfectly good to the man in Squash Center. But *who* is Mr. John Johnson, and why should anybody buy stock in anything because *he* is behind it?

A crooked scheme which is entirely legal (strange as such a combination must appear), which has been worked in the past and which may well be worked in the future, is this:

Mr. Easy Mark invents something, anything—let us say a match-box that lights the match when you open it. Mr. Easy Mark must be, for the purpose of this game, a person with a bit of money of his own. Preferably he will be a man who is in business in some other line, and who very reasonably does not want to devote the time necessary to trying to make something of his invention. So he patents it and looks about for a purchaser of the patent. To him comes a smooth talker who inflates the value which Mr. Mark puts on his own invention. In the end he offers to purchase, not the whole patent, which he "is not equipped to handle," but the rights to manufacture the match-box under the patent and to sell it, say, in a single state or group of states. "I will buy the New England rights from you," says the stranger: "what will you sell them for?"

Mr. Mark had thought of asking five thousand for his patent. But the smooth stranger has given him a new idea of its value. Evidently if it is worth this prosperous gentleman's while to buy rights for a small territory, the thing is worth more than the inventor had at first supposed. So he does some mental arithmetic, decides that the patent is worth fifty thousand, and that the New England rights ought to bring him at least two thousand. The smooth stranger goes up in the air, protests, haggles, brow-beats, declines, backs water—and finally succeeds in buying the New England rights for eight hundred dollars. Then he disappears from the scene.

Shortly thereafter another stranger appears who wants to buy the patent. With fifty thousand already in his mind as a beginning, with the successful sale of the rights to a small territory as an accomplished fact, with another man wanting to buy into the patent, Mr. Mark is completely sold with the idea that his patent is a thing of great value indeed. So he asks a hundred thousand. The second stranger also haggles and brow-beats and finally agrees to pay sixty thousand dollars for the patent and all its rights. Whereupon Mr. Mark recalls, or the stranger drops some remark about the location of his factory and his first selling campaign which reminds Mr. Mark, that he has already sold a slice of the pie in the form of New England rights. "Then the deal is off," remarks the second stranger: "I don't want it if I can't control it absolutely."

Mr. Mark argues but the prospect is adamant. Sixty thousand for the whole he will pay; but not sixty cents unless he can own it absolutely. It is a good thing and he could make money out of it, but he won't touch it if he has to face competition, if he has to advertise goods that another man can make and sell in part of his territory. Go sell the whole thing to the man who bought the rights, is his parting word.

But Mr. Mark finally gets him to agree to leave the offer open for a week, and goes after the purchaser of the New England rights. He finds him without any trouble. He probably puts an alternative proposition to him: Buy the whole patent for sixty thousand (or more), or sell back the New England rights. Neither proposition tempts the gentleman: he simply can't handle the whole patent, but he can and will handle the New England end. So Mr. Mark, with sixty thousand dollars dancing at the end of the rainbow, starts bidding for those New England rights. A thousand, two thousand, three thousand, does not tempt the holder. Finally he sells these valuable rights back to Mr. Mark for $9,500—very reluctantly, and only because this sum represents his profits from the sale of the box for a period of sufficient length to make it an object to get the money right away, in cash, available for further transactions. Everything about the whole game, it will be seen, has been eminently plausible and calculated to quiet any tendency on the part of Mr. Mark to be suspicious. And now he breathes easy again; he once more owns his own patent, his sixty-thousand-dollar patent, outright. It has cost him something, but he stands to net fifty thousand, and he recalls that a few weeks ago he would have sold the whole thing outright for a tenth of that sum.

So he hunts up the sixty-thousand-dollar man. But for some strange reason he cannot find him—and he never does find him. The two strangers divide $8,700 between them, the fruit of an agreement that nobody can prove, a little talk, a little cleverness—and the match-box that lights the match when you open it remains for ever after in the exclusive possession of Mr. Easy Mark.

The moral? Beware the purchaser who offers to buy something from you, provided you will do something that involves the spending of your own money. Look

(Continued on page 500)

LAST week Mr. Claudy told in more or less general terms of the broad field of operations open to the stock jobber whose offering is based on a project for the ostensible manufacture of a patented article. This week in the last of the present series, he descends to details, and describes several typical schemes by means of which the investor or the inventor or both are now and again defrauded. It is not to be understood that these exhaust the subject, or that the precise details of any of them are to be duplicated in any fraudulent undertaking that may come along tomorrow or the next day. But they are well representative of the general methods employed in such schemes, and present a sufficient variety of attack to cover the field fairly well. Any proposition bearing the distinctive features which Mr. Claudy points out as characteristic of his frauds should be investigated with the utmost thoroughness before it is accepted as genuine. The marketing of inventions and stock in inventions is a business subject to the general principles that govern all other business; and Mr. Claudy's moral is that these principles should be rigorously applied by anyone who is approached with a buying or selling proposition of any sort.—THE EDITOR.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Efficiency of Gases in Cutting Operations

To the Editor of the SCIENTIFIC AMERICAN:

In the January 17th issue of the SCIENTIFIC AMERICAN under the caption "A Competitor for Acetylene," what I consider some very misleading information and data appears with respect to cutting operations. In the first place, it is really a mistake to call acetylene, calorine, hydrogen or carbo-hydrogen cutting gases. The cutting operation is performed entirely by an oxygen jet and the other gas is used simply as a pre-heating agent to heat the metal to a degree where it is keenly susceptible to the cutting action of the oxygen. A welding torch produces the flame which is sometimes over 6,000 degrees Fahrenheit, but this does not cut the metal away. A cutting torch, on the other hand, will perform this operation because it is so constructed that when the operator sees that the metal to be cut has reached a certain degree of heat due to the pre-heating flame, he turns on a jet of pure oxygen which does the actual cutting work.

The cutting of iron or steel is a chemical action and not a mechanical or melting one. Oxide of iron burns and is consumed at a lower temperature than the metal itself, therefore in an atmosphere of oxygen molten iron or steel will oxidize, the oxide will burn, creating intense heat, keeping the metal always at the melting point and as rapidly as new oxide is formed it is burned until the iron or steel is completely consumed.

This being the theory covering the operation it can plainly be seen that cutting is accomplished by exposing a heated area of metal to a stream of oxygen. On this assumption, acetylene and other such gases used in conjunction with oxygen in cutting, are not entitled to the name "cutting gases." They merely perform the preheating operation necessary before the jet of oxygen can accomplish its work.

The purity of this oxygen cutting jet has a most important bearing on its efficiency as such. Taking 99½ per cent pure oxygen as a unit, a drop of 10 per cent in purity causes an 11 per cent increase in oxygen consumption and almost a corresponding increase in the time necessary to complete a given piece of work. Oxygen 98 per cent pure is only 75 per cent as efficient as 99½ per cent pure gas.

This well-known deleterious effect of even small amounts of non-combustible gases while cutting steel with oxygen makes me take great exception to the following paragraph:

"From these premises it can be seen that a successful cutting gas should be one which is unsaturated, contains a liberal amount of carbon, combined with the lowest possible proportion of a slow burning gas, and has a high rate of combustion."

Scientific investigation seems to show that carbon is not desirable in a "cutting" gas because a part of the gases resulting from the combustion of the preheating gas is drawn into the cut by the suction of the oxygen jet. These gases naturally dilute the oxygen and due to the fact that a very small amount of non-combustible impurities in the oxygen will have a material effect on the efficiency of the cutting jet, I maintain that carbon is therefore an undesirable element in a preheating gas, as it forms large volumes of carbon dioxide upon combustion, which dilutes and impairs the efficiency of the oxygen cutting jet. Take acetylene for example. The chemical equation of its union with oxygen is $2\ C_2H_2 + 5\ O_2 = 4\ CO_2 + 2\ H_2O$. This shows only the molecular relation, however, and to get a real understanding of the amount of carbon dioxide involved, the volume entering into the reaction must be considered: of acetylene 4 volumes, of oxygen 10, of water 4, of dioxide 8. This means that every volume of acetylene produces its own volume of water vapor and twice its volume of carbon dioxide as a result of combustion with oxygen, and in cutting operations these resultant gases are bound to dilute the oxygen jet thereby rendering it less efficient.

On the other hand the reaction of hydrogen when used with oxygen for cutting can be expressed as $2H_2$ (4 vols.) $+ O_2$ (2 vols.) $= 2H_2O$ (4 vols.) Accordingly, I maintain that pure hydrogen is superior to any other gas generally used in cutting operations because its combustion produces the least amount of non-combustible gas to dilute the oxygen jet. Hydrogen will produce a flame of 4,000 degrees Fahrenheit which is all the heat necessary for preheating; and for heavy cutting, where the purity of the oxygen is so important, pure hydrogen seems to be superior to any other gas on the market. A somewhat recent issue of the SCIENTIFIC AMERICAN describes the dismantling of the Heligoland fortifications by means of oxy-hydrogen flame. The illustrations testify as to the efficiency of this method.

When cutting with acetylene or similar hydro-carbon gases, the pressure on the oxygen jet has to be greater than when pure hydrogen is used because of the diluting effect of the carbon dioxide explained above. This of course means increased oxygen consumption and a proportional increase in the cost of the cutting operation.

In any manufacturing operation, the cost is an important consideration. Mr. Walter P. Schuck of Portland, Ore., proved that in certain kinds of cutting the amount of oxygen saved by using hydrogen instead of acetylene was great enough to make the cost of the entire amount of gas used, both oxygen and hydrogen, less than the cost of the oxygen alone when using acetylene. Many manufacturers are now using the oxy-hydrogen process for cutting in preference to the oxy-acetylene and a growing demand seems to prove its efficiency.

DON. B. MCCLOUD.

Chicago.

The Universe as It Might Be

To the Editor of the SCIENTIFIC AMERICAN:

I have sometimes noted in the scientific press remarks about scientific misinformation in the daily papers. The enclosed clipping is taken from one of the dailies here, and is altogether too rich to remain a secret.

KENNETH BRYDEN.

Albuquerque, N. M.

"Vice-President Hodgin gave a very instructive talk to the Hi Y Club yesterday at the Y. M. C. A. He told the story of the stars, the vastness of the universe. There are eight planets in our solar system, but they are not lighted bodies like the earth. Some stars are so far away it takes one hundred years for their light to enter the earth at the rate of 18,600 miles a second. The size of the sun is equal to a million of our earths. If the sun were hollow and the earth placed in its center and the moon where it is now the earth could revolve 240,000 miles from the sun and there would still be 200,000 miles to spare. The sun is the smallest of the heavenly bodies. Some stars are 1,000 times bigger than the sun.

"The earth rotates around the sun every 24 hours making a circle of 240 000 miles, 1,000 miles an hour. The sun revolves around the earth once a year at the rate of 1,000 miles a minute. The whole planetary system revolves in a space of 150,000,000 miles a year.

"Pleaides reveals six stars to the human eye, the telescope shows 2,500 stars, photographic plates 7,000 stars. Our great telescopes and spectroscopes, and cetellial photography are going out as if by magic into the great abyss of space and are bringing back the long hidden secrets held by the stars."

[The above is a faithful transcription of the clipping sent us by Mr. Bryden—verbatim, literatim et punctuatim—we will display the original to anyone who doesn't believe it. We trust that Vice-President Hodgin is not a violent man.]—THE EDITOR.

The Hydra Raises Its Head

To the Editor of the SCIENTIFIC AMERICAN:

In the *Atlanta Constitution* of January 25th, 1920, the statement was made in the current news items—"The Swiss Government is manufacturing alcohol from calcium carbide treated with hydrogen, using a process *discovered in Germany*."

The words underlined state an error. May I not ask your correction of it by recalling my article printed in the SCIENTIFIC AMERICAN for June 9th, 1897, also your editorial notice of my work in developing and perfecting the method of Berthelot which was put forth in 1860? The editorial notice in a later number, SCIENTIFIC AMERICAN, June 13th, 1903. In that editorial due credit is given me as the first man in the United States to employ the method of making alcohol from calcium carbide and acetylene gas. I first produced it in 1894. Both Berthelot and myself have been done an injustice. Both *The Iron Age* and *Mida's Criterion* copied your editorial notice of January 9th, 1903. The latter added this concluding paragraph:

"We are pleased to accord honor to whom honor belongs, and we trust that Prof. Lynes will favor us with a communication on the present state of the synthetic *ethyl* alcohol and state its nearness to being a success commercially."

Much of Germany's accredited position at the head of the industrial arts in 1914 was due to systematic propaganda leading to the false impression that all things good originated in Germany. Do we not see in this incident an indication that the Hun is again embarking on methods of the same sort?

J. COLTON LYNES, Ph.D.

Marietta, Ga.

Molybdenum

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of March 27th, page 336, you give the pronunciation of the word as mo-lyb'-de-num. Allow me to point out that the best authorities do not agree with you. The Century Dictionary, the Imperial, and, best of all, the New English Dictionary, now approaching completion, say mo-lyb-de'-num. The Standard agrees with you and Webster gives both forms.

AVERN PARDOE.

Toronto.

[*On etymological grounds the accent would fall on the third syllable; but the usage of the technical world has ruled in favor of the pronunciation given in the* SCIENTIFIC AMERICAN. *The dictionaries are necessarily behind the times to the extent that they favor the classical pronunciation.*]—THE EDITOR.

"Deflocculation"

To the Editor of the SCIENTIFIC AMERICAN:

In Mr. Claudy's article on Acheson, the Father of the Lubrication of the Future, in your issue of March 27th, appears the following statement:

More interesting even than an interesting life, is the inside history of what he believes to be the greatest of his discoveries—a fine mouthful of a word you shall find in no dictionary—"deflocculation."

I am wondering what dictionary Mr. Claudy is in the habit of using. I find the word in question in Funk and Wagnall's New Standard Dictionary, in the form deflocculated as well as deflocculation; and the definition refers specifically to the example of the phenomenon afforded by graphite.

W. G. MARTIN.

Bryan, Texas.

[*We rather wonder ourselves what dictionary Mr. Claudy uses. It is so common an occurrence to find that the growth of technical demands upon the language has outstripped the dictionary that it did not occur to us to question Mr. Claudy's statement until Mr. Martin suggested that we might have done so; whereupon we found that the word occurs in the* 1914 *edition of the Century, at least, if not in earlier editions.*—THE EDITOR.]

The Watch as a Compass

To the Editor of the SCIENTIFIC AMERICAN:

Referring to Mr. Frederick Skinner's article, page 361 of the April 3d issue, I differ as to the accuracy of his statement that "The result is *always* true north and south."

As is well known, our clock time is *mean* solar time, and it does not follow that the sun is in the zenith at 12 o'clock noon as shown by the clock hands. In fact at this latitude and longitude, 38° 54'N., 77°03'W., the sun is in the zenith at 23 minutes past clock noon from February 7th to February 15th; and at 8 minutes before clock noon from October 24th to November 12th. These are the extreme variations and may readily be obtained by adding algebraically 8'12" (longitude correction) to the equation of time (which may be obtained from the Solar Ephemeris and Nautical Almanac, published yearly by the Naval Observatory, D. C.).

Mr. Skinner's suggestion is an excellent one, however, and probably would suffice for most occasions.

IRVING F. HAND.

Washington, D. C.

Reversal of Image

To the Editor of the SCIENTIFIC AMERICAN:

My attention was called to a communication in your last issue on the reversal of the photographic image. Your correspondent seems totally to misunderstand what is meant by this term. It refers to the fact that under extreme over-exposure a photographic negative on development appears as a positive, although ordinarily reversal occurs in only a portion of the image. It has nothing whatever to do with a geometric inversion or transposition of the image from top to bottom or from left to right. The theory of the reversal has been explained by Abney and other photographic authorities.

ALBERT CONE.

Chicago.

Subduing the Boll Weevil

At Last a Successful Means of Dealing with the Worst Present Mexico Ever Made Us

By George H. Dacy

TWENTY-FIVE million acres of cotton annually are exposed to the ravages and despoliation of Mister Boll Weevil, peer of all southern crop parasites. Heretofore, efforts to subdue and control this cotton pirate have been uniformly unsuccessful but recently Uncle Sam through his official representative, the National Department of Agriculture, has ascertained that calcium arsenate dusted over the cotton bolls at the proper periods will make these host plants so obnoxious to the weevils that they will shun fields treated in this manner. As a consequence the potential saving of hundreds of millions of dollars worth of cotton is promised as the boll worm has been the serious impediment which has determined the success or failure of every native cotton crop since this objectionable invader was introduced from Mexico in 1894 on infected cotton which was brought across the border to be ginned.

The calcium arsenate is most efficacious in the powder form and is most easily applied in this condition. The most favorable conditions for dusting occur at night when the air is calm and the humidity high, conditions which promote the drifting of the chemical over the field and its permeation to every part of the cotton plant. Of course the fact that the protective work has to be performed at night complicates matters because at night the labor usually is careless and inattentive unless closely supervised; driving the teams which haul the dusting machines is doubly difficult while repairing the machines in case of breakdowns is far from easy.

Thus far a two-wheeled, arched-axle cart duster, with the power furnished by the traction wheels, which have sprocket chains running from them to a jack shaft on the car platform, has proved most efficient. The jack shaft carries ratchets on the ends and a friction clutch through which the power is transmitted for operating the fan and feeder on the machine. The ratchets on the ends of the shaft engage the small sprocket wheels and permit the traction wheels to run backward without turning the shaft, so that when turning at the row ends, one wheel can drive the shaft, and keep the machinery running, thus producing a continuous flow of dust. One man can drive and operate this machine without difficulty. The rate of the dust distribution is proportional to the speed of the team so that uniform spreading of the poison always results.

Spreading the poison with hand guns, though occasionally necessary, is slow and expensive work except in odd corners

THE cotton boll weevil has always been one of the most dreaded of crop pests. The extent to which it has ranked, with the chestnut blight and a few other prize nuisances, among the things for which there is no cure, is amply shown by the methods employed for combatting it. Briefly, these consist in abandoning the cultivation of cotton in the regions where it has become established, and the enforcement of a rigid quarantine against these regions on all commodities in which the insect could possibly travel. This may be effective; but it can hardly qualify as an enlightened method of dealing with the situation; and it need cause no wonder that the quarantine in question, as well as the prohibition of cotton planting, has sometimes had to be enforced with a sawed-off shotgun. But Mr. Dacy tells us that all this is a thing of the past—that at last there has been found a direct way of dealing with the pest.—THE EDITOR.

The storage barrel has a capacity for 200 pounds of calcium arsenate, it requiring from three to five pounds of the chemical to poison one acre of cotton. A successful dusting includes covering all parts of the plants with the exceedingly fine particles of the chemical and this of course means that the finer the material is broken up, the more efficient will be the control.

In the perfection of dusting machinery, Uncle Sam had to exercise special care to make these mechanical assistants as simple and foolproof as possible because, for the most part, the implements are designed for operation by plantation negroes who are careless and incapable of handling intricate machinery. It is also difficult to get the southern field hands to work with poison due to erstwhile fatal results in bygone days when the attempts to utilize Paris green as an eradicator of the boll weevil proved more injurious to the field workers who applied the poison than to the insects themselves. Colored laborers also fear the dew, this superstition aiding to make it difficult to secure hands to poison the cotton plants at night.

Hand guns made of light-weight sheet-metal have been used for spreading the poisonous chemical over the cotton fields although the dread of the colored folks of dew and the poison has made it almost impossible to conduct this control measure on any extensive scale. Furthermore, the work is very laborious and an operator cannot continue at it for more than three or four hours at a time. Efficient work consists in poisoning one acre an hour with one of the hand guns. Although not adapted for extensive utilization as control mediums on large fields, these calcium dispensers are useful as supplementary to the use of large power dusting machines.

Large power machines which have been carefully tested out under practical field conditions are qualified to perform rapid and efficient work when operating properly, ordinarily poisoning one acre in about ten minutes. They permit of carrying about one-half a ton of dusting powder on the machine which eliminates the necessity of stopping frequently to take on more ammunition. On the other hand, these outfits are objectionable in that they weigh about one ton apiece and are cumbersome to handle as field machines, while the four wheels do more or less

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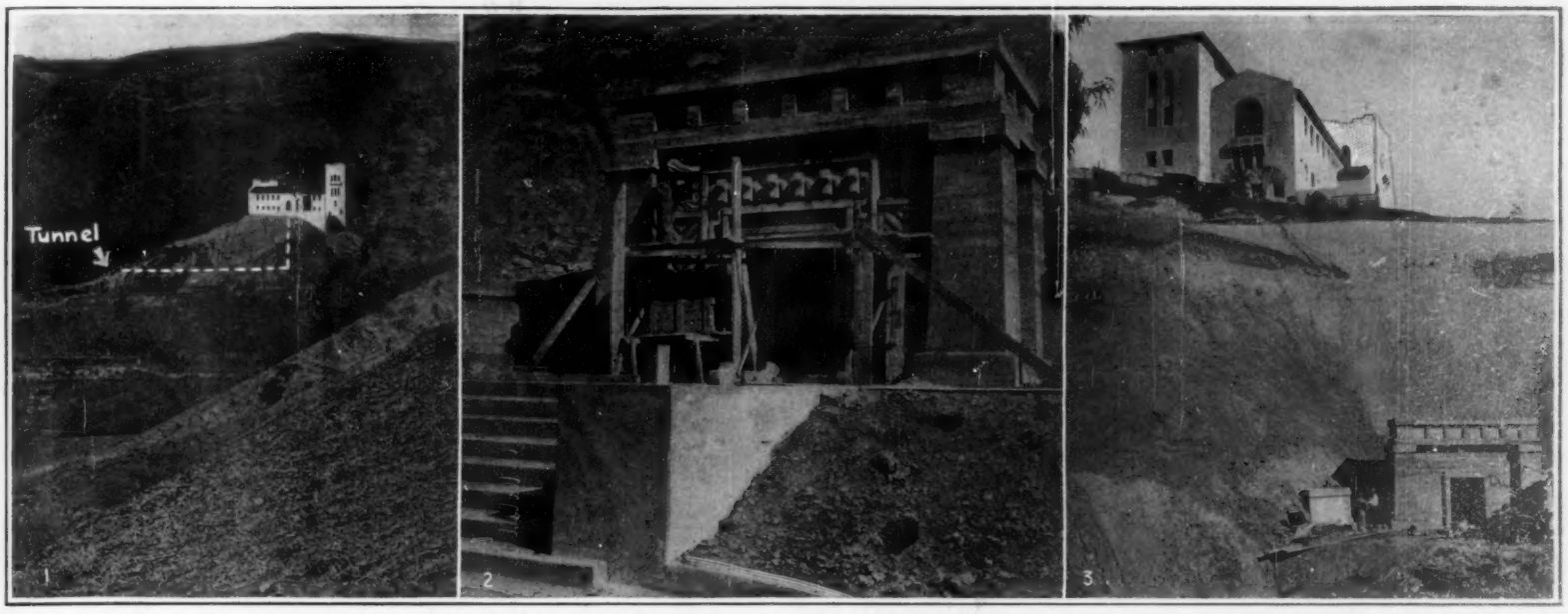
1. The four-wheeled power machine, though heavy and cumbersome and requiring a skilled driver, still has its good points when it comes to a big job of spraying. 2. Rear view of the two-wheeled, arched-axle cart which has proven the most effective dust-spreading device. 3. Another aspect of the small machine shown in the second picture.

The poison-spray offensive against the boll weevil, king of cotton-crop pests



1. View of the museum from the hills one mile distant, showing how the new entrance is laid out. 2. A detail of the Mayan ornamentation which will adorn the entire entrance tunnel, making it an integral part of the museum. 3. The museum building and the new entrance—108 feet below and nearly 300 feet distant

Los Angeles' museum on a hill-top, and the novel entrance tunnel and elevator through which it is reached

The House on the Hill with Front Door in the Valley

By John L. Von Blon

WHEN choosing the site of the Southwest Museum in Los Angeles its founders permitted themselves to be swayed by sentimentalism and located it on the city's loftiest hills, out toward Pasadena, commanding some of the finest mountain and sea views in all California. The people, for whose free use and benefit the great institution was reared, proved to be devoid of analogous sentiment. Neither the gold-and-rose Pacific sunsets nor the treasured exhibits within the walls could tempt them to climb the steep heights. So for five years a quarter-million-dollar citadel of popular education stood forlorn and silent the while a feasible scheme was evolved to make it accessible to the prosy world. A happy and novel plan finally was hit upon; twelve months ago work was begun, and now it is nearing completion. A one-legged man can reach the building in less than half a minute. Already visitors are flocking there.

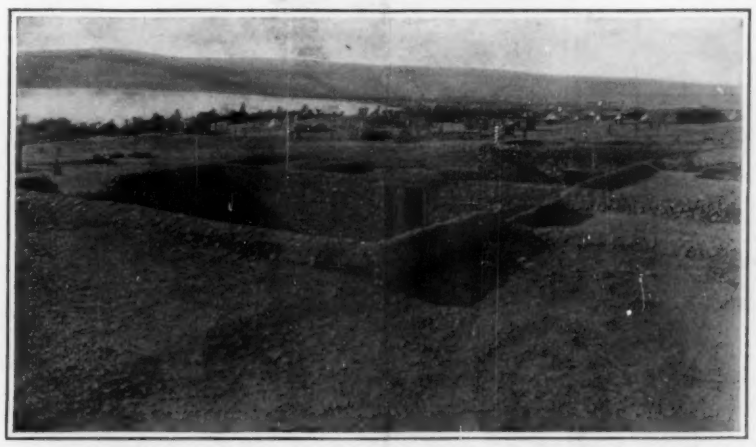
The object is achieved by means of a tunnel into the hill to a point directly under the structure, and a shaft leading upward in which an elevator is operated. Thus the main entrance to the museum is placed nearly a hundred yards away horizontally and a hundred feet beneath the foundations. To all intents and purposes the stiff grade is eliminated, the picturesqueness retained, and the institution made as approachable as the average skyscraper. While no outstanding engineering problems are involved it is a unique application of a common method. The construction, of concrete with steel re-enforcement throughout, is massive, in keeping with the imposing pile above it, and fabricated to endure through the ages. Five thousand tons of concrete is used. The cost exceeds $50,000.

Beginning at the nearest street elevation in the mouth of a deep ravine off the southern end of the building, the subway is 261½ feet long, 12 feet high in the clear and 8 wide. It leads to an octagonal waiting room 18 x 12½ feet with 16-foot ceiling. From this is entered the elevator shaft, 7 x 9 feet and 108¾ deep or high, to the front center of the edifice overhead. The tunnel walls vary from 9 to 20 inches in thickness. The walls of the shaft are 9 inches thick and the corner pillars uniformly 18 inches square. The outer portal is 24 feet across the face, 16 tall and 12 deep. Save a small chamber at either inner side it is solid.

Only the usual obstacles and dangers of driving bores were encountered. The formation is hard sandstone and comparatively loose shale and the way was blasted through. Operations were simultaneously started at the top and side of the eminence and the shaft and tunnel diggers met, appropriately, where is now the waiting room. An interesting feature of the tunneling was the unearthing, far within the hill, of a number of fossils constituting a valuable addition to the many on the museum's shelves. These came from the shale and date back to the Miocene. One is an oyster nearly eight inches long which thus far has not been classified. While of unusual size from the viewpoint of the present it is not large for its period, having been contemporaneous with giant shells. Like others of that time it is fluted, while the surfaces of oyster shells now disclose no regular lines. Its identification is eagerly awaited by conchologists throughout the country. Many fine speci-

(Continued on page 501)

Bureau of Standards furnace for melting sand in the manufacture of enameled ware



Underground houses in Akaba, Arabia, afford protection from the intense heat

Development of American Clays

By S. R. Winters

CO-OPERATING with the manufacturing industries, the Enameled Metals Section of the U. S. Bureau of Standards is making investigation of the physical and chemical problems involved in the manufacture of enameled metal articles. While the enameling of metal as an art is an ancient industry the science as applied to utilitarian articles is of comparatively recent origin.

The use of enameled kitchen utensils has developed with amazing rapidity, the United States manufacturing $20,000,000 worth annually. Germany and Austria, our chief competitors, are suffering from the expansion of the industry in this country. "At the present time the United States holds the predominating position in the South American trade," says Homer F. Staley, Metallurgical Ceramist of the Bureau of Standards, "and it is hoped that this country may continue to enlarge its market in this and other foreign fields."

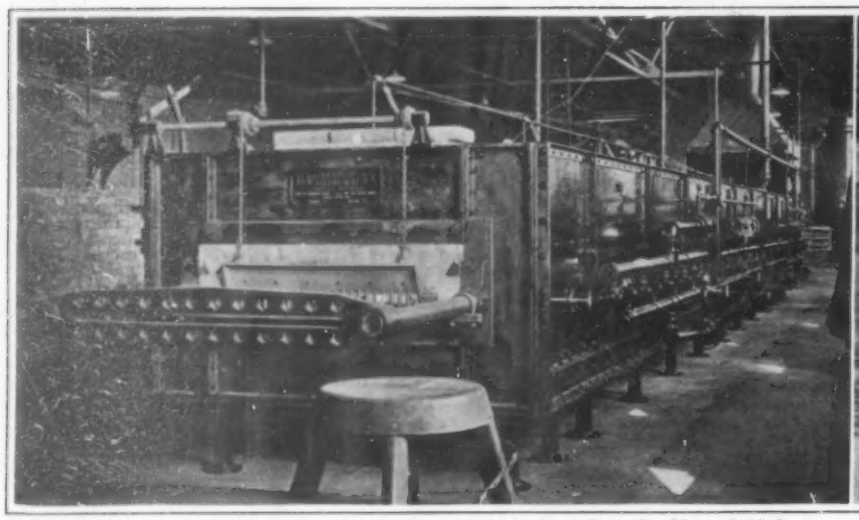
The enameling of stoves, refrigerator parts, cash registers, scales, and automobile parts gives examples of the extension of the use of this beautiful and sanitary coating to sundry articles. Enamels are used in such minor industries as watch and clock dials, and various grades of jewelry, ranging from the ten-cent store variety to the exquisite and expensive examples of the jeweler's art.

The business of manufacturing enameled cast-iron wares for plumbers' articles, such as bathtubs, lavatories and sinks has attained enormous proportions—a $25,000,000 business yearly in the United States alone. This country leads the world in production of this class of ware—both in quantity and quality—making large shipments to South America, China and India.

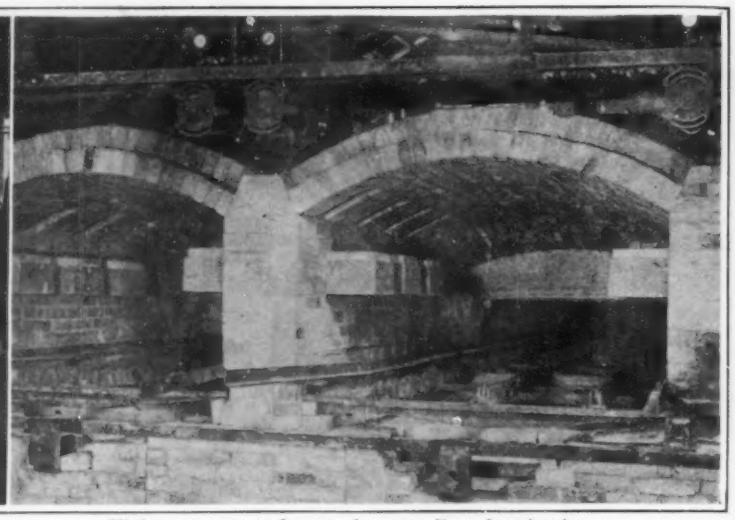
The Bureau of Standards conducted in 1919 300 tests of clays, fire bricks, feldspar, flint, whiting and other ceramic materials. The coöperative work with the United States Potters' Association in eleven plants at East Liverpool, Ohio, has been completed, the results assuring the manufacture of pottery entirely from American clays.

Keeping Cool By Living Underground

OUT in the newly created Kingdom of Arabia, the natives live underground in order to escape the torrid heat of the desert. The accompanying view of Akaba, taken from the roof of the house of Emir Faisal, shows two typical dwellings in the foreground, the roofs of which are flush with the surface. These underground houses are delightfully cool, spacious and quiet.



Gas-fired wire annealing furnace. Width of hearth 36 inches. Length of hearth 50 feet



High-pressure gas furnace for annealing glass bottles

Annealing with Gas

The Ways, Means and Results of This Often-Mentioned Process

By W. A. Ehlers, M. E.

THE process of annealing steel is for three purposes: To relieve any strains in the material caused by hardening, rolling, forging or punching operations; to soften the material in order that it may be machined easily at minimum cost; and to produce the maximum refinement in the granular structure of the material, so that when it is heated for hardening and then cooled, the expansion and contraction in all parts is equal. Annealing consists in heating the steel to some predetermined temperature (depending upon the kind of steel to be treated and the result to be obtained) and then slowly cooling it. In the majority of cases the temperature required is somewhere between 1,200 and 1,700 degrees Fahrenheit.

It is very important to heat the steel uniformly and slowly but not too long. The work must be so placed in the furnace that all parts may become heated evenly, and when it has been heated through to the proper temperature the fire should be cut off immediately. Any variation in the temperature or uneven heating will cause some parts to be coarse grained and brittle while other parts will be more refined and ductile. Annealing is thus accomplished by a complete change in the composition of the steel throughout by converting it into an entirely new structure, then upon slow cooling other transitions take place in the structure of the steel, which bring it back to its original constituency.

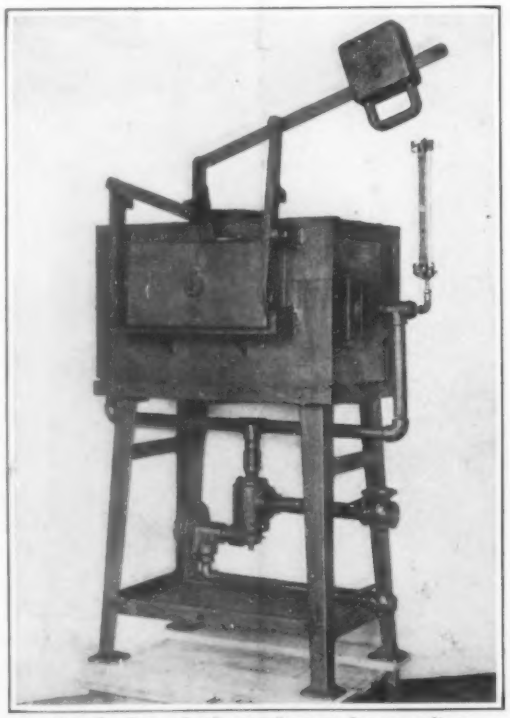
Thus it is at once apparent that the temperature and conditions of the heating zone of the furnace are of utmost importance. There are a number of things that tend to influence this condition, the most important of which is the kind of fuel used and the methods of its application. Since practically all fuels require a certain amount of free oxygen to support combustion, it is obvious that the best results will be obtained (all things being equal) with the fuel that will admit of an automatic means of proportionally mixing the oxygen with the fuel.

Coal, coke and oil by reason of their physical properties are not well suited for automatically mixing with air in the proper portions for complete combustion. Since all fuels must reach a gaseous state before combustion really takes place it is obvious that a commercial gas of the proper composition and heating value would be the logical fuel to use.

Low carbon steel, to be fully annealed, should be heated to about 50 degrees Fahrenheit above the upper critical temperature of the steel, or from 1450 degrees to 1700 degrees depending upon the percentage of carbon. The lower the carbon the higher the temperature required. For high carbon steel the annealing temperature should vary from 1500 for 0.85 per cent carbon to 1350 for 1.5 per cent carbon. If the temperature is allowed to exceed these limits to any extent the structure of the steel is very much changed, and becomes "burnt."

The heating and cooling operations may be accomplished in several ways. Where it is desired to keep the furnace in continuous operation the steel may be heated to the proper temperature and then buried in sand, lime or ashes, which act as a slow conductor of heat and this produces a slow cooling. Very slow cooling, on the other hand, may be accomplished by allowing the material to remain in the furnace after the heat has been shut off. This method can only be used where the furnace is of good construction and the air eliminated by sealing the doors and all other openings. Another method of slow cooling is to pack the steel in granulated carbon, charred bone, charred leather, fire clay, sand or slaked lime, placed in an iron box and heated to the proper temperature and then allowed to cool entirely before being removed from the boxes.

WHEREVER we see metals discussed we meet the word "annealing." Everybody knows that this is a process for making the metal better in some way; but precisely in what it consists, precisely what are its effects, and precisely why it is done, are questions on which a large majority of the interested laymen would flunk out hopelessly. The present article aims to answer them in a manner free from technicalities, so far as annealing by gas is concerned.—THE EDITOR.



Standard gas-fired oven furnace for annealing

Bright annealing is desired in many classes of work and may be accomplished as follows: Place the steel in iron boxes and seal them by means of clay or sand to prevent any air entering the box. Screw a small gas pipe into the box at a convenient point and also provide a small hole at the opposite side of the box. Turn gas into box and the escaping gas will burn at the opening. In this way all the air will be driven from the box and no oxidization of the steel will take place.

Another method of quick annealing may be accomplished by a combination of furnace and air cooling. Heat the steel slowly to a little over the upper critical temperature (1500 to 1750 degrees Fahrenheit). Shut off the heat and allow the steel to air-cool to a little below the lower critical temperature, but never lower than 700 degrees, then reheat the steel to a temperature of about 1200 to 1250 degrees and allow to cool in air or in the furnace. This method produces a very tough steel.

High carbon steel, when annealed for machining only, need not be heated to a greater temperature than 1200 degrees but if it is desired to relieve the metal of stresses produced in forging, etc., the temperature should be maintained at about 1450 degrees with an excess of carbon in the furnace, in other words a reducing atmosphere to prevent scaling.

Large quantities of manufactured gas are being used at the present time for annealing steel and copper wire. One of our photographs shows one of several similar gas-fired furnaces now being used for "patenting" steel wire which is primarily an annealing process. This furnace has a hearth 3 feet wide and 50 feet long, and has a capacity of 1500 pounds of wire per hour. Gas is supplied at high pressure and the required amount of air is automatically controlled by means of a proportional mixing device. It has replaced oil as a means of heating.

In another situation where large quantities of copper wire are produced the manufacturer has applied gas to several muffle-type furnaces with such success that he finds them to be not only cheaper to operate than when using soft coal, but in addition the material is of a much better quality. This is due to the uniformity of the temperature, and the close regulation of the temperature at will. A point not to be lost sight of in the annealing of wire in direct-fired furnaces heated by gas is the control of the furnace atmosphere, consequently a reduction in scale to the minimum.

Until quite recently many manufacturers of brass stamping have adhered to the idea that wood was the only form of fuel which could be used successfully for annealing brass stamping. The fallacy of this idea has been proven by several manufacturers after thoroughly testing gas-fired furnaces. In one situation the writer was consulted to make recommendations for re-

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U. S. Navy airplane fitted with air bags which are normally deflated but can be instantly inflated to permit of alighting on water

What Europe Is Doing in Aviation—Americans, Please Take Notice!

By Eric A. Dime

IN a lecture given on March 23rd before the New York Electrical Society, Mr. Handley-Page, the English pioneer in aviation and in the airplane's commercial development, stated that he has invented a new method of plane construction whereby he is able to reduce some 66 2/3 per cent the power required to drive an airplane at high speed. A commercial passenger- and express-carrying biplane that would normally require 900 h.p. to drive it at, say, 100 miles per hour, with a useful load of a ton-and-a-half, will now give the same, or a slightly better performance, with but 300 h.p.

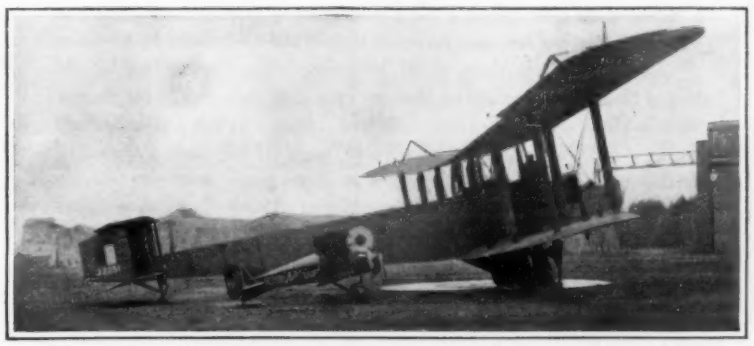
Thus the cost of operation is enormously reduced, making commercial aviation entirely practical and of prime importance, as Mr. Page's company has proved it to be since last September, even with the use of its ordinary machines. In its daily London-Paris and London-Brussels service the company's machines have covered 83,000 miles and carried 4,000 passengers and 50,000 pounds of express matter without any accidents or losses. Six hours' time is saved in going from London to Paris, and the tiresome railroad journey and Channel crossings are avoided. The fare by air is but $60, while express matter is taken at about fifty cents a pound, or at less on a large contract.

This air service, coupled with the 95 per cent or better efficiency of the air mail service in this country (which has saved the Post Office Department many thousands of dollars), would make it seem as though the Government should make the economic move of not only extending its first-class mail service across the continent, as it has recently appropriated $1,400,000 to do, but also of starting parcel post air lines as well. As a result of the new discovery, the 600-h.p. bimotor Thomas-Morse machine illustrated in one of our recent issues, instead of carrying 1,500 pounds of mail at the rate of 130 miles an hour, can be made to transport as great a load as does the huge quadruple-motored L.W.F. twin-fuselage mail plane at practically the same speed. Thus invention has made possible an improved mail service at a lower cost, the same as 50 years ago, the Editor of this journal, Alfred Ely Beach, introduced the rapid urban transportation of letters through pneumatic tubes, thereby saving time and expense as appreciated by the French to-day with their "petit Bleu," though not by Postmaster General Burleson, who has deprived New York of this special delivery service.

Mr. Page's invention shows the economic advantage to be gained by any Government in financially aiding inventors of things aeronautic, as the French Government is doing in order to obtain the first practical helicopter. America has probably progressed further

(Continued on page 502)

Nieuport single-seater in which Sadi Lecointe, the French airman, broke the world's speed record by attaining 192 miles per hour



Two extremes in aviation—the Handley-Page passenger carrier and the sporting Austin "Whippet"

Air Bags for the Airplane That Lands on Water

By George Gaulois

SHORTLY after the war we came to know about the small airplanes used on Allied battleships and started from platforms laid along the turret guns. But in the various descriptions of these diminutive airplanes practically nothing was said about what happened after their reconnaissance flight was made; that feature was left to the reader's imagination.

The truth of the matter is that the pilot of one of these small naval planes was left to his own resources, once he left the platform aboard the battleship. In order to make the utmost speed and give the greatest climbing rate, the airplanes were fitted with the usual landing chassis, and no provision was made for alighting on water. It was a matter of getting to land or falling into the water; and in the latter event the pilot had about one chance of being saved and four of losing his life. Yet the pilots went about their work just as eagerly as those flying above the battlefields.

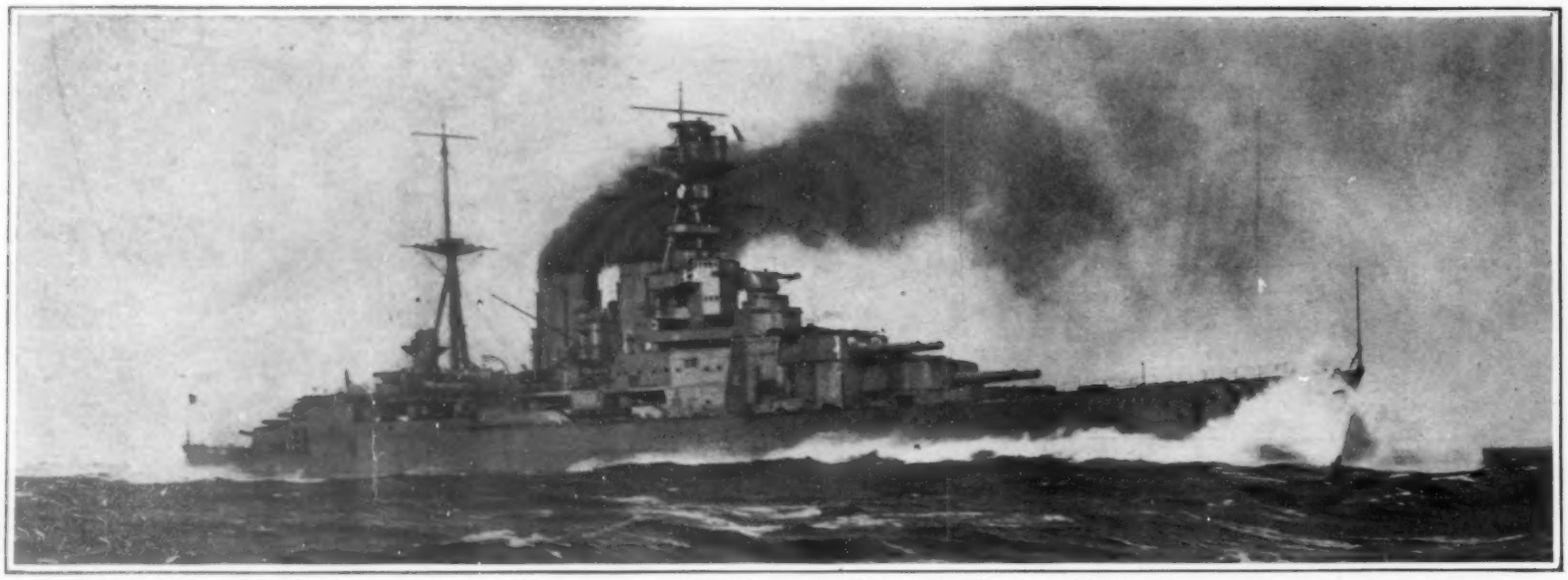
Some consideration for the naval aircraft pilots has led to the introduction of air bags as part of the equipment of naval airplanes. This idea, a British one originally, has now been applied by the U. S. Navy, as shown in the above illustrations. Normally, the bags are neatly folded alongside the forward portion of the fuselage; but when the pilot is forced to alight on water, the bags are instantly inflated by means of a flask of compressed air or gas. The airplane then becomes an aquatic craft and can float for hours.

Novel Lens Cleaner

ALMOST any ordinary medium that can be used is likely to smear and even scratch a lens in the cleaning. A very perfect lens cleaner can be made by using the medulla or pith of such plants as sun-flower rush, or elder. Strips of the dry pith are cut and these are fastened with an adhesive to a piece of cork. The pith may be arranged in rows with small spaces in between. The lens is rubbed gently with the novel cleaner and all marks disappear.

Copyright, Kadel & Herbert

Passenger compartment and general view of the Vickers commercial airplane which has proved so successful in Great Britain and elsewhere



Battleship "Hood." *Length*, 860 ft., *beam*, 104 ft., *mean draft*, 28½ ft. *Mean Displacement*, 41,200 tons. *Speed* (contract), 31 knots. *Guns:* eight 45-cal., 15-in.; twelve 5.5-in.; four 4-in. anti-aircraft. *Armor;* Belt, 12-inch; gun positions, 12 to 15-inch; total weight of armor, 13,800 tons. *Torpedoes:* two 21-in. submerged; four 21-in. above water.

The Battle-Cruiser "Hood" steaming at full power over the measured mile near Arran Forth of Clyde on March 18, 1920

The Backbone of Naval Power

British Confidence in the Battleship as Exemplified in the "Hood"

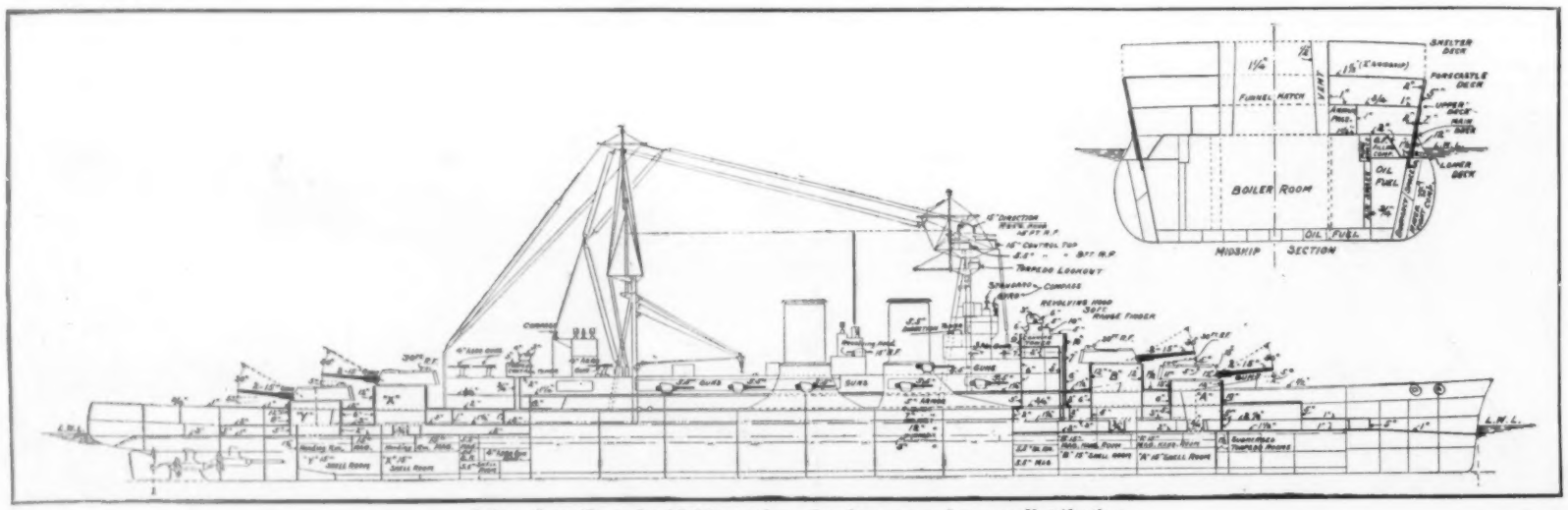
By Hector C. Bywater

SOME of the older officers of the British Navy of distinguished name and brilliant record have been telling us that the submarine and the airplane have sounded the doom of the battleship. Mr. Bywater, one of the ablest of the British naval critics, does not agree with them and in the present article on the 31-knot battle-cruiser, "Hood," he tells us why. Particularly significant is it that the younger officers who fought the late war are more than ever convinced that the battleship is the backbone of the navy—an opinion which has recently been expressed in a formal statement of policy issued by the British Admiralty.—THE EDITOR.

"IN our opinion the capital ship remains the unit on which sea power is built up. So far from the late war having shown that the capital ship is doomed, it has on the contrary proved the necessity for that type. On the German side the whole of the submarine campaign against merchant vessels was built up on the power of the High Sea Fleet. On the British side the enemy submarines in no way interfered with the movements of capital ships in carrying out operations; destroyer screens, new methods of attack, and altered tactical movements defeated the submarine." The foregoing extracts from a statement of policy issued by the British Admiralty on March 12 clearly indicate the direction of British naval development within the immediate future. Although signed by the First Lord, Mr. Walter Long, the memorandum is known to have been written by Admiral of the Fleet Earl Beatty, with the full concurrence of his professional colleagues on the Board, all of whom held commands afloat for the greater part of the war. *It is a very significant fact that the opponents of the big ship are, practically without exception, retired officers who have had no experience of modern warfare. On the other hand, nine out of every ten officers who served afloat in the late war—from admirals down to sub-lieutenants—are convinced that great armored ships are as essential to the command of the sea as ever they were,* and that their supremacy is still unchallenged, despite the admitted powers, actual and potential, of submarines and aircraft. Nor is this view confined to the British Navy. Both in the United States and Japan, capital ships of the largest dimensions are now building; while Admiral Scheer, late commander of the German High Seas Fleet, states in his recent book that "the big ship—battleship and battle-cruiser—is, and will be, the main strength of naval power." It will be seen, therefore, what little justification exists for the charges of hide-bound conservatism which have been preferred against the British Admiralty on account of its decision to perpetuate the capital ship, rather than trust to underwater and aerial weapons for the defense of the Empire.

One reason why the new British battle-cruiser "Hood" has attracted such universal interest is the widespread popular belief that she is destined to be the last ship of her kind. As I have said, this view finds no support in practical naval circles. It is, of course, very probable that capital ship design will undergo drastic modification in the future, consequent upon improvements in those methods of attack which she has most reason to fear. Engineering progress also is bound to affect the design, and the Diesel-driven, funnelless battleship, with guns possessing an all-round arc of fire, is a conception of the near, rather than of the remote, future. Later still, the battleship may take unto herself the power of diving below the surface; but, as the Admiralty statement observes, "such types are visions of the far future, not practical propositions of the moment." The "Hood" deserves all the attention which has been bestowed upon her, not because she is likely to be the last of her type, but because she most nearly approaches the ideal in capital ship construction ac-

(Continued on page 502)



Inboard profile and midship section, showing gun and armor distribution

1. Interior of cookhouse and mess hall. Notice the good quality of utensils used. 2. Looking down on roofs of some of the buildings. The careful construction of the camp is very evident here. Farther up in this view may be seen the dam taking on its shape. 3. Temporary road camp in distance, and cookhouse under construction.

Some features of the model construction camp in California

The Fuel Case of Coke vs. Coal

By Henry Townsend

THE question is often raised, especially at the present time, when the use of coke is becoming quite common for household and other purposes, as to which gives the most heat, coke or coal.

If you should ask your coal dealer, he would usually say either one of two things, to wit: that his coke gives *as much heat* as high grade coal, or that it gives much greater heat pound per pound, compared with the best grade of anthracite or hard coal.

Exhaustive engineering laboratory tests on every conceivable grade of coal and coke from all parts of the United States, including foreign cokes and coals, prove to those seeking the technical facts in the case, that there is no fuel resembling coal which gives a greater production of heat pound for pound, by any combustion, than high-grade A1 anthracite or hard coal such as that coming from the leading Pennsylvania coal mines. This coal gives 14,000 b.t.u., the standardized unit of heat production, each b.t.u. representing that amount of heat required to raise the temperature of one pound of pure water, one degree Fahrenheit or from 62° to 63° Fah. for instance.

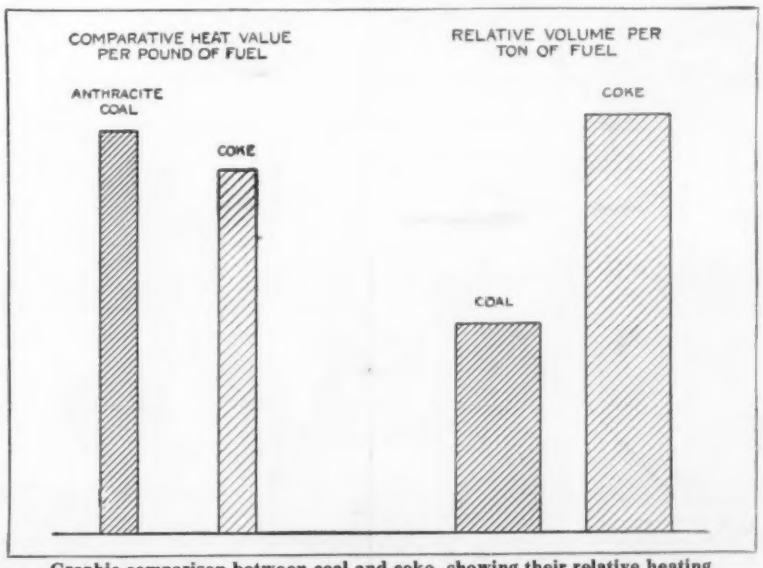
So, we now have all the information necessary, by which engineers judge the heat producing value of fuels, no matter what their nature may be. The best grade of coke made from coal of selected grade *gives but 12,600 b.t.u.'s per pound.* It is therefore obvious that if we burn one pound of A1 high-grade anthracite coal and one pound of the best coke obtainable, in a test run in a furnace or boiler, that the coke will show only 9/10ths the heat efficiency of the coal.

Therefore, you have but to ask your coal dealer one question when he endeavors to persuade you to buy his coke —which, of course, has many desirable features, such as cleanliness and free-burning qualities—and that is, "How many b.t.u.'s per pound does your coke test? If his figures agree with the above, approximately, then he is telling the truth; but if he says that 1 pound of his coke gives more b.t.u.'s than a pound of A1 anthracite coal, he is evading the truth; for actual laboratory tests have shown us the real results, and these are to be found in any engineering handbook.

As a common delusion, it is often the case that when coke is first used in the place of coal, it is infinitely and in some mysterious way wonderfully superior to the burning qualities of the coal, which has been previously used. This is a fallacy, pure and simple, as the above data indicates. This fallacious idea may be exploded by the following reasoning, which shows how such a delusion may easily be entertained.

In the first place, it all depends on *what kind of coal and what grade of coal* (there are 75 different grades of coal in the American market alone) was employed *before* coke was used. If this coal was a low grade fuel, which undoubtedly is often the case, and yielded, as some low grade anthracite does, say but 7,000 b.t.u.'s per pound, then, of course, one pound of coke would look as good as two pounds of coal. Most likely it would seem so to the layman; and in view of the fact that he invariably has no exact data on the heating value in b.t.u.'s per pound of the coal previously used, he has no means of comparison whatever with the coke. However, if the grade of anthracite used previously has been up to the standard, as is

(Continued on page 503).



Graphic comparison between coal and coke, showing their relative heating value and their relative volume

Keeping the Construction Laborer Satisfied

By Allen P. Child

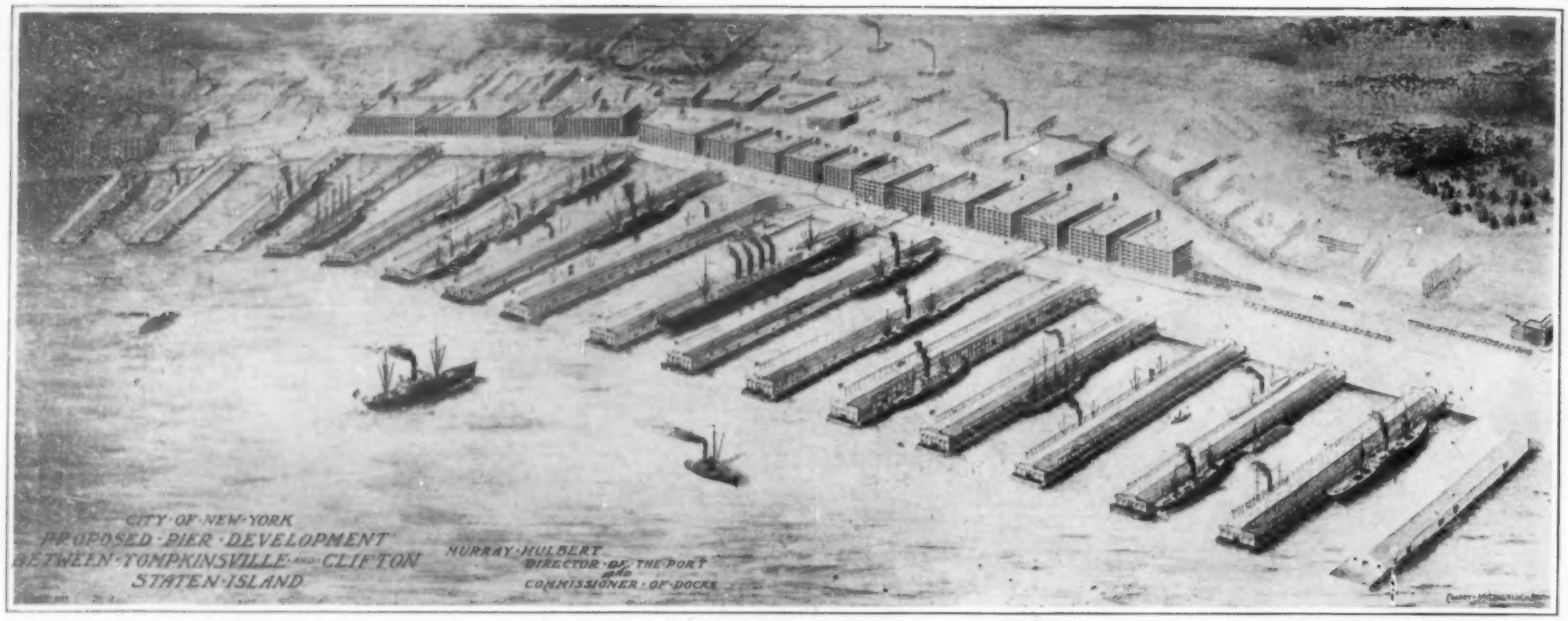
THOSE folk whose lives are seldom in contact with the living conditions around immense construction projects, carry around a picture of dirty, torn tents and muddy, or dusty scenery all about. To a certain extent they are correct in their conjectures and their memories do not always belie them. For there is rarely a sight of more unkempt shiftlessness than the camps of construction gangs as we are accustomed to seeing them in the vicinities of our large cities.

But now comes the model construction camp. And it is considered so by many persons who have visited it as well as the powers that be in California, which regulate housing conditions. Situated on the steep and forested hillside of the San Joaquin River Canyon, near Fresno, California, it furnishes accommodations for a large number of workmen employed in building a dam for backing the water of the San Joaquin River up two miles to the power house which will generate 45,000 horse-power when in operation. This dam will be, when completed, 400 feet in length at the top, 100 feet in height and 50 feet at the bottom. Over 30,000 cubic yards of concrete will be placed in the forms.

The headquarters buildings with the cook houses and store-rooms are located in one central part of the camp. Situated above the other bunk houses and buildings is a small settlement of single tent houses accommodating the families of laborers who are married and wish to have their families with them. All the buildings are screened in during the summer months and when the colder days of the winter arrive strips of canvas are stretched around over the screening. Each structure has a substantial wooden floor and the roofs are boarded up, which adds to the comfort of those occupying them as well as making much more simple the task of maintaining a sanitary camp. Every building used as a cook house or a dining hall is supplied with double doors which serve to keep out the meddlesome California flies.

This is the best illustration of just the way progressive Westerners are going after a solution of labor difficulties and they have come to see that the man who is doing this sort of work is entitled to consideration and just as comfortable living conditions, under the circumstances, as the man who works in the city and has a home, approaching some degree of comfort, to resort to when his day's work is completed.

The accompanying illustrations convey a clear impression of the nature of the buildings and equipment as a model construction camp.



Airplane view of the new Staten Island Development as it will appear when proposed marginal tracks and warehouses have been built

The Steamship Pier Problem

Considerations Which Governed the Design of the Twelve New Staten Island Piers

IN releasing for publication in the SCIENTIFIC AMERICAN the plans of the great system of municipal docks which is to be built at Staten Island, Murray Hulbert, Director of the Port and Commissioner of Docks, affords the citizens of the United States an opportunity to become acquainted with the broad outlines of this undertaking. We say the citizens of the United States, for these terminal docks affect the welfare not merely of New York City, but of every shipper throughout the country. The Port of New York differs from every other great port in the world in the important particular that it has no belt railway parallelling or encircling its whole water front, and in this respect it is under an enormous handicap. In the first place, the port is split apart by two wide and deep waterways, the Hudson and the East Rivers, which not only isolate Manhattan Island (the heart of the whole city), but shut out the many great railroads that approach the city from the West by barriers which are impassable by direct railroad traffic. Consequently, so far as freight is concerned, the transfer has been effected by a vast fleet of lighters and steam tugs. This is necessarily a slow and expensive system of distribution.

Lack of Railroad Interconnections at New York

For reasons which are somewhat obscure, the railroad systems of the country seem to have made very little effort to extend their freight lines directly to and along the water front of our port. Each road has been content to run its lines squarely up to the water front, say on the Jersey side of the Hudson River, put up a passenger terminal, and let it go at that; but of any collaboration to link up the individual railroads by a great belt system encircling the entire port, there seems to have been no signs until the last few years; and what has been attempted of late years has so far proved to be abortive.

We might mention here three of these later propositions, one proposed by W. J. Wilgus, formerly Chief Engineer of the New York Central, which contemplates a belt line swinging off across the Hudson from the New York Central above Yonkers, then turning to the south and intercepting the western railroads some twenty miles back from the Hudson; then reaching Staten Island by a tunnel at Perth Amboy, and Long Island by a tunnel at the Narrows; and finally encircling Jamaica Bay, which is destined to become one of the greatest deep-sea shipping centers at New York. Another proposal is that of Gustav Lindenthal for a belt line intersecting the Jersey Terminal roads, crossing the Hudson by bridge at Fifty-ninth Street, extending as an elevated marginal railway along the west shore of Manhattan, and returning to New Jersey through a tunnel at the Battery.

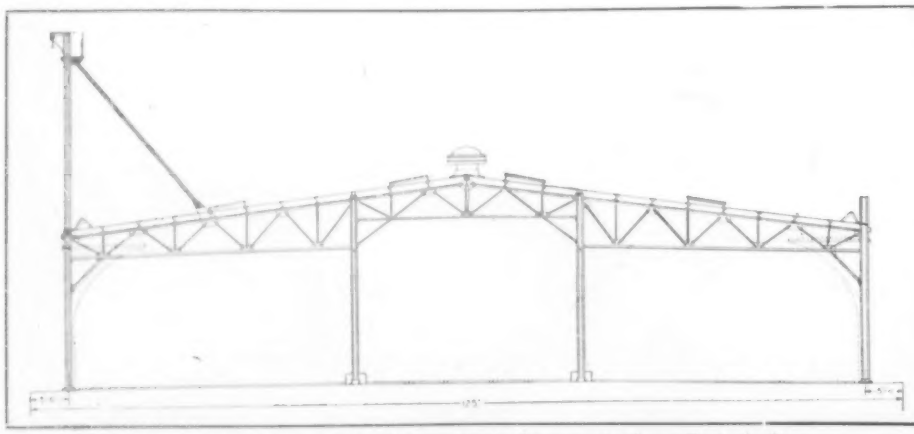
There is also the scheme of Calvin Tompkins, the former Dock Commissioner, for the construction of freight tunnels from New Jersey to Manhattan and from Manhattan to Long Island, so as to give continuous rail connection from the interior to any point on the whole water front of the port of New York.

Direct Rail Access to Piers Necessary

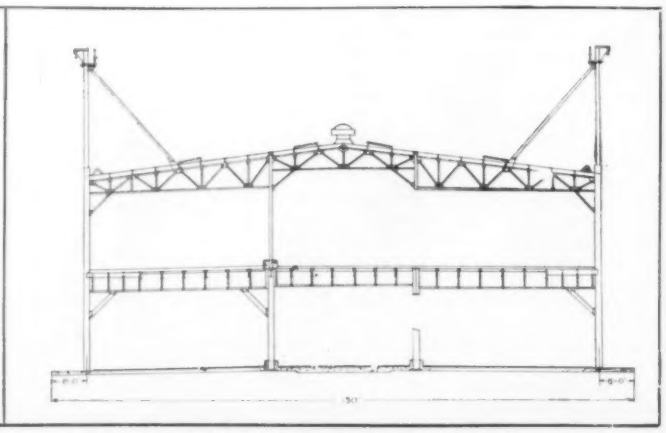
Now the presence of direct rail access to the water front in foreign and most other American ports, and the absence of such facilities in the port of New York have resulted in totally different types of piers and methods of handling freight. In cases where the freight cars can be run directly alongside the ship, the ability to transfer cargo directly from car to ship or from car to shed to ship, coupled with the realization that time and labor-saving are of the most vital importance, has led to the construction of piers of liberal width equipped with power-operated cranes of great flexibility of movement. Where several parallel lines of track and broad piersheds are to be built on a pier, great width of pier is necessary, and the accompanying list of piers, including those to be built at Stapleton, bears out this statement.

Maximum Sizes of Piers at Leading Ports of the World

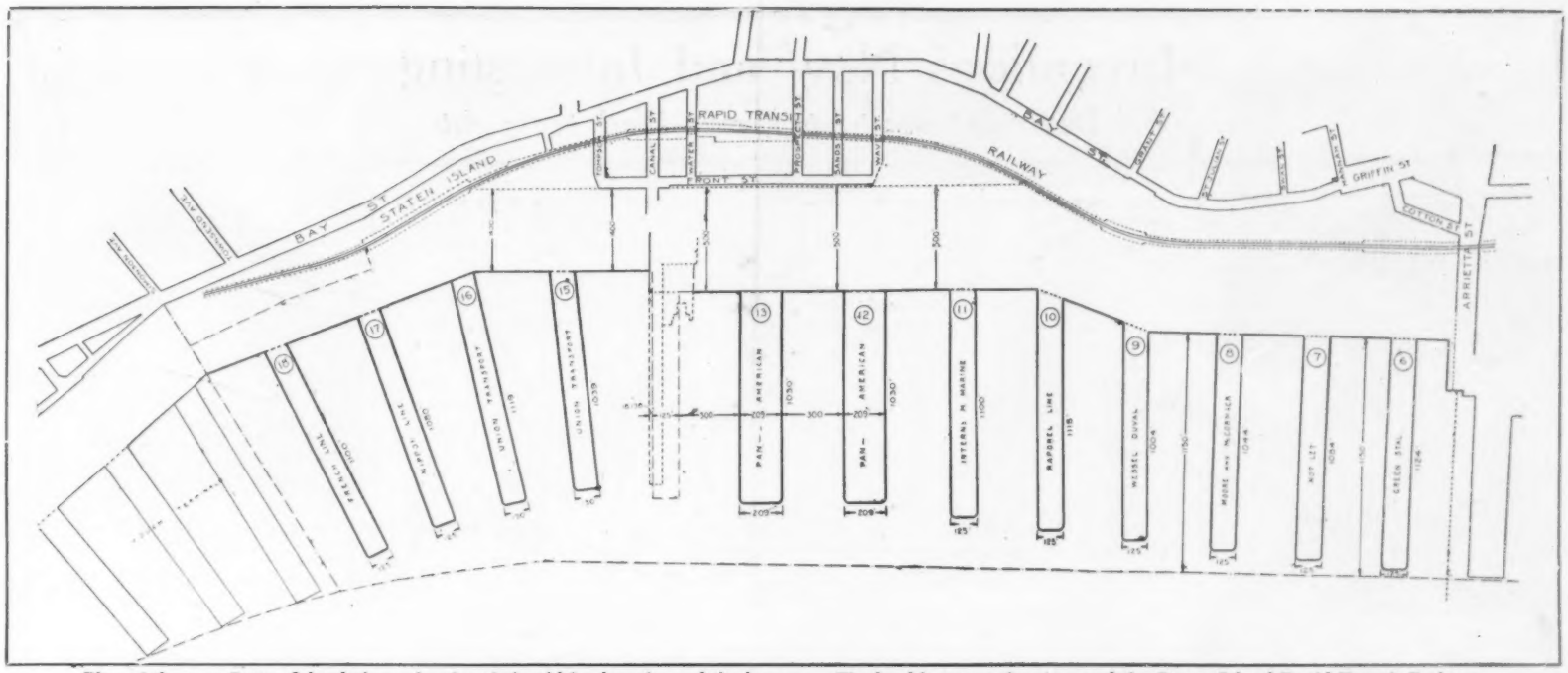
	Width	Length
European Ports:		
Antwerp (proposed)	1000 ft.	4000 ft.
Hamburg	550 "	3000 "
Marseilles	430 "	1318 "
London (Tilbury Docks)	400 "	1000 "
Manchester	275 "	1250 "
American Ports:		
Buenos Aires (proposed)	667 "	1930 "
Portland, Oregon	480 "	1350 "
Boston	400 "	1200 "
Halifax	340 "	1250 "
Montreal	300 "	1250 "
Philadelphia	300 "	1200 "
San Francisco	200 "	981 "
Baltimore	200 "	1450 "
New York (proposed at Stapleton):		
8 of	125 "	1300 "
2 of	130 "	1300 "
2 of	209 "	1300 "



Type of single-story shed with two tracks down center bay. To be built on the eight 125-foot piers



Double-story shed with two center tracks. To be built on the two 130-foot piers



Plan of the new Staten Island piers, showing their widths, lengths and the lessees. The land between the piers and the Staten Island Rapid Transit Railway belongs to the city and will be converted into a large freight yard by the B. and O. Railroad

The Advantages of Wide Piers

On many of the piers, such as those at Hamburg, in addition to the many tracks, there is what might be called a transit or temporary shed for freight that has to wait from a few hours to several days, and also a many-storied warehouse for freight that may be held there for several months, all built upon the same pier. In the case of other piers, the storage warehouses are erected on the shore side of the marginal road from which the piers extend. The latter arrangement is the one proposed ultimately for the Staten Island improvement.

Now, with the exception of the two piers 209 feet in width, it will be evident from the above table that those at Staten Island are very much narrower than are to be found at other leading ports both in America and in Europe. At the same time, Commissioner Hulbert points to the fact that of the 400 commercial piers at the Port of New York, only 14 are greater in width than the minimum 125-foot pier of the Stapleton development, and only one is wider than the 209-foot piers at Stapleton. Furthermore, in only one case at this port is there a slip wider than the 300-foot slip adopted as the standard width at Stapleton. There are 30 piers at present at this port which are 125 feet in width and more, and at these the average width of pier and slip together is 396 feet, whereas the Stapleton piers and slips together will have a range of width from

(Continued on page 504)

The Photo-Engraver at Work

OUR cover this week depicts a scene in a photo-engraving establishment—a trade in many ways the most remarkable of all the modern mechanical lines. The old-fashioned wood-engraver would have scoffed at the suggestion that he would ever be displaced by automatic processes, which would make it unnecessary tediously to cut all the separate lines of the design on the block. Yet this is precisely what has happened, and all through the happy thought of photographing through a "screen."

The screen is in effect a network of lines, arranged in two perpendicular sets, and spaced with a mesh of from 60 to 175 lines to the inch. Many things have at one stage or another been employed in getting this screen, from an actual wire net down. The really up-to-date device consists of glass plates with fine lines ruled on them—but with one vital reservation. You can rule 175 parallel lines in an inch on a sheet of glass, and have the result look like something; but the endeavor to rule 175 lines crossing the first set would result in sad confusion—the glass would not stand up in the minute squares left between the lines of the two sets. So a clever American inventor ruled his first set of lines on one sheet, and his second set on a second sheet, and glued the two sheets together around the edges. And this double-sheet screen is used today in practically all half-tone work.

The rays which pass from the object through the lens to the sensitized plate pass also through this screen. The result is that the image shows not the solid lines and blocks of color of the original, but rather these lines and blocks broken up into a pattern of fine points or dots. These are necessarily the same distance apart everywhere, center to center; but corresponding to the darker places on the original, which project less light through the lens and screen, the dark dots representing the images of the openings in the screen are of smaller size; corresponding to the light places on the original, from which more light is sent out, the images of these holes are larger. A block of large dots gives to the eye an impression of greater color than a block of small dots; the result is that the original is actually reproduced on the negative in a pattern of dots. The degree of enlargement or reduction is of course controlled to a nicety by moving the camera closer to or farther from the object, which is lighted by two intense electric arcs. Exposures run about five minutes or a bit longer.

When the negative is developed a problem arises. Optically, in terms of lights and darks, it is a negative as its name indicates; geometrically, in terms of right and left, top and bottom, it is likewise a negative. A contact print made from this negative will be reversed optically and geometrically, becoming a positive in both senses. If then we fasten this on a press and take an impression, this will be optically a positive

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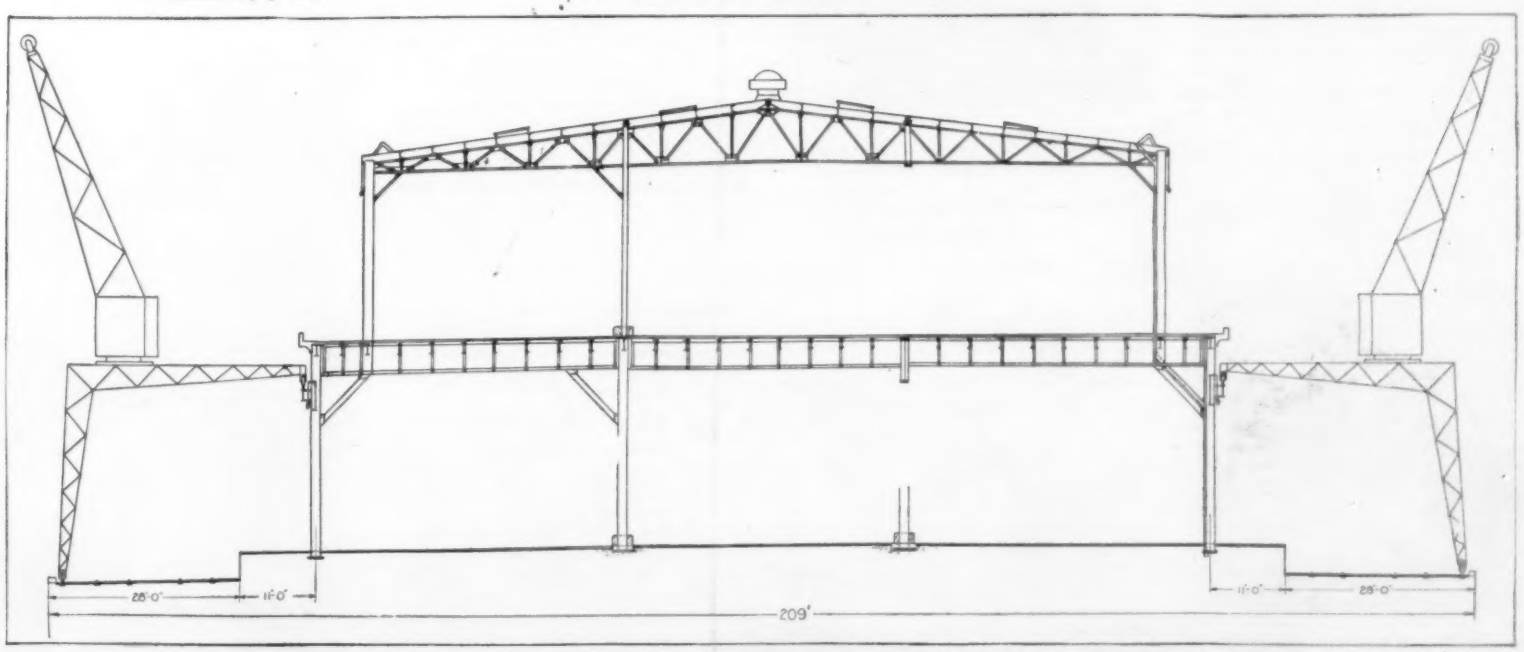
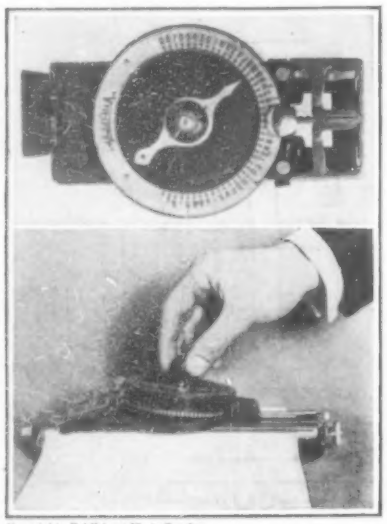


Two-story shed to be built on two piers of 209-foot width. There will be two tracks on each side of shed, served by many, half-arch, gantry cranes

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



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Two views of the portable typewriter of pocket size

The Pocket Typewriter

THE portable typewriter is now an old friend. It has remained for a French constructor, under the stimulus of war-time prices and war-time scarcity of the regular models, to evolve what can, without any stretching of the truth, be described as a pocket typewriter. The machine in question, of course, is not designed to compete with the ordinary models for the routine office work, but is simply offered as a portable typewriter *par excellence*.

The operating principle of the new machine is simple enough. It gets away from the necessity for type-bars by an expedient not very different in principle from that employed on a well-known American machine which offers wide variety and wide scope of keyboard rather than operating ease. Instead of the cylindrical plate bearing numerous parallel rows of characters, the French machine uses a flat circular plate, much like that on the toy typewriter that was sold in this country some years ago. The characters are distributed in a single circle around the lower surface of this plate, with the keys immediately above them on the upper surface. An element of complete novelty, however, consists in an arrangement which gives the effect of an upper and lower "shift."

Each type slug carries a single character, it is true; but the type runs around the complete circumference of the lower circle, while the "keyboard" occupies but half the circumference above. The act which selects the letter, number, etc., to be impressed upon the paper consists in turning the arrow indicator, shown on top of the instrument in our photograph, until the pointer is directed to the character in question. The "shift" is effected by means of the double-ended nature of this pointer; when the long, sharp end is addressed to the M key, as in the illustration, the small letter (or the lower of the two signs) prints; when the blunter index is employed, the capital letter or the upper of the two characters shown on the "key" functions. This, it will be seen, makes it unnecessary ever to turn the index through more than a semi-circle.

It will be understood that this machine requires two acts for the impression of each character. The rotation of the index to the proper point, as just described, merely selects the letter that will be printed. It is then necessary to press down on the central handle by means of which the index was turned; and this pressing effects the printing. This pressing down of the printing hub likewise operates the spacing mechanism, as on a regular machine.

This tool makes tight connections between hose and metal fittings

Progressive Exercises with a Sliding Weight

A WELL-KNOWN French athlete has recently invented the simple exercising device shown in the accompanying illustration. This device consists of a handle, a heavy stem, and a sliding weight. The farther out the weight is moved along the stem, the more weight is brought to bear on the hand holding the device. In this manner it is possible to engage in progressive exercises, starting with the weight close to the handle and gradually shifting it outwardly as more exertion is desired.

Copyright, Kadel & Herbert

This device prints a receipt for the fare due the taxicab driver

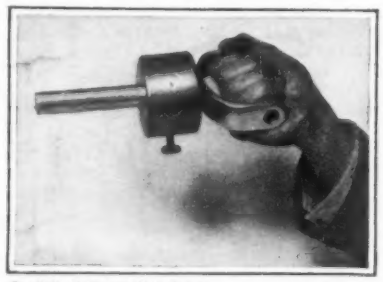
A Device That Makes Hose Connections Tight

FROM France comes the hose tool shown in the accompanying illustration, by means of which it is now possible to make tight connections between hose and metal parts.

In brief, this device makes use of ordinary wire formed into a simple double loop, as shown in the illustration. One end of the loop is passed through the other and brought to a catch on the tool. This catch can be raised by means of a screw thread operated by the wheel at the top. In practice, a loop of wire is placed about the hose and connected with the tool, and then the wheel is turned so as to make the loop tight; finally, the tool is pushed over so as to bend the free end of the loop over the other part, and the long and surplus end is cut off close to the point where the wires wrap around the first end. The action is rapid and simple, and ensures tight connections.

Weaving in Leather

IN answer to the steady demand for novelties, John Bleaufeux of Brooklyn, N. Y., has developed a series of new leather goods based on the weaving principle. The leather pillow case, shown at the right of the accompanying illustration, is made up of 1600 square inches of glace kid, the material being in strips and woven in and out in the same manner as the weaving of paper patterns by children. At the left appears a shopping bag, also made by weaving strips of glace kid. Two colors of kid are used in order to obtain the pleasing checkerboard effect. Because of their novelty, softness and good wearing qualities, these leather innovations have been much sought by the trade.



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The sliding weight on the stem increases the weight to be handled

When the Taxi-cab Driver Gives a Receipt

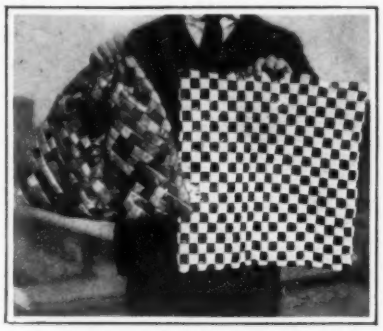
CERTAIN manufacturers of cash registers and sales books have, through years of persistent advertising and commercial propaganda, got the buying public into the habit of demanding a receipt with each purchase. The habit is an excellent one, to be sure, for it places even the smallest transaction on a strictly business-like basis, and does much to avoid misunderstandings and disputes.

And now we come to the latest recruit to the army of receipt givers—the taxicab company. In place of the conventional meters with their dials whose rapidly rising figures, forever staring in the face of taxicab riders, take all the joy out of this otherwise pleasant form of transportation, a New York taxicab organization has recently introduced the new recorders shown in the accompanying view. These meters are operated in about the same manner as the usual meter; but instead of giving a direct reading for the fares, a printed ticket giving the total fare is secured at the end of the ride by the manipulation of a lever. In this manner the passengers are guarded against overcharging or dishonesty.

A Fire Alarm System Which Telephones Its Message

FIRE alarm systems there are which give excellent results as far as the actual premises are concerned, but do not communicate with the outside world, hence in many instances fail to achieve their purpose. What good is it to detect a fire in a given house, if the fire department is not notified in time to give effective protection?

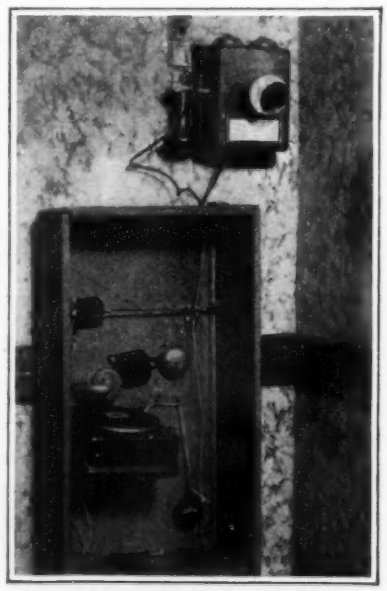
Working along certain lines with the foregoing conclusions before him, William J. Luce, a fireman of New York City, has developed a most ingenious fire alarm system which actually telephones the information to Central and thus ensures speedy assistance. The action is said to be positive and absolutely automatic.



Shopping bag and pillow made of woven glace kid strips

Briefly, Luce makes use of thermostats located at intervals of 25 feet or one for every room of the premises to be protected. These thermostats—little switches which close a circuit when they are heated above normal temperature by fire—are placed in a circuit supplied with current by one or two dry cells. As soon as a fire breaks out in any part of the premises thus protected, the battery circuit is closed and by means of electro-magnets, the calling apparatus is set in motion.

The release of a weight by means of the energized electro-magnets serves to lift the telephone hook, while a phonograph is started up. The record on the phonograph tells where the fire is, street, house, floor and room, if necessary, and repeats the message over and over again for several minutes. In this manner the Central is bound to get the necessary information, which is transmitted to the nearest fire house. The telephone message may be as follows: "Hello, Central. Notify Fire Department Headquarters, 1,000 Rhinelander, that there is a fire at 312 West 20th Street, fourth floor, rear, apartment 10."



A fire alarm system which telephones the information to Central

Copyright 1920, by The Goodyear Tire & Rubber Co.

BEGINNING May 1st, 1919, a six months' test of solid versus pneumatic truck tires was conducted by Mandel Brothers, operating a large downtown dry goods store in Chicago. The test was supervised by the company's chief engineer, Mr. Alfred Johnson. Two trucks were used, No. 44 on solid tires and No. 45 with Goodyear Cord Tires on the rear wheels and other pneumatics on the front wheels. Both trucks were employed in regular city delivery work, handling similar loads over similar routes. The results of the test, given below, have caused the company to order recently several trucks on pneumatics.

	Truck No. 44 (Completely equipped with solid tires)	Truck No. 45 (Completely equipped with pneumatic tires)	Difference in favor of pneumatic equipment
Number of days operated	130	146	12.3% increase
Miles traveled	5,388	6,719	25% increase
Miles per gallon of gasoline	5.5	7.2	31% increase
Repairs per mile	$ .0109	$ .0057	47% saving
Labor cost per mile (drivers)	$ .20	$ .176	12% saving
Operating cost per mile	$ .353	$ .335	5% saving

NOTE: The actual saving in operating cost amounted to 1.8 cents per mile. Such a reduction grows to a very substantial sum of money when multiplied by thousands of miles of service.

The detailed cost records of similar comparative tests of solid and pneumatic truck tires, in different classes of hauling, can be obtained by writing to The Goodyear Tire & Rubber Company, Akron, Ohio.

GOODYEAR
CORD TIRES

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

FLYING MACHINE.—M. LECUYER, Villers-Cotterets, France. The invention relates to flying machines of the kind in which a supporting surface carries suitable apparatus for drawing in and discharging air, and means for directing the currents of air produced by the said apparatus downward, upward, or rearward for the purpose of causing the ascent, descent or propulsion of the flying machine. The apparatus for drawing in and discharging air consists of fans with vanes or blades, half of the fans revolving in one direction and the other half in the opposite direction.

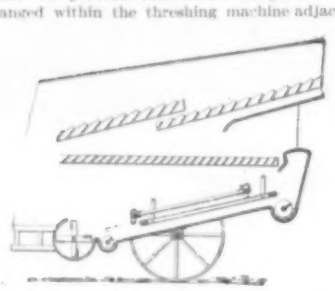
Electrical Devices

TROLLEY WHEEL.—J. LEFKOWITZ, 34 Eleanor Ave., Schenectady, N. Y. This invention relates particularly to wheels intended for use upon electric wires for conveyance of electricity for power and lighting. Among the objects is to provide a wheel having side flanges adapted to move with respect to each other or the hub, whereby provision is made for either or both of the flanges to be automatically tilted in any direction so as to bring the plane oblique to the axis of the hub, the flexible side flanges being also less likely to leave the wire than solid wheels.

ELECTRIC HEATER.—J. R. GOLDTHWAITE, Box 137, Troy, Ala. The object of the invention is to provide a simple and inexpensive heating device primarily intended for melting wax when sealing and whereby the melting can be done on the spot where the seal is to be formed. With the device a wax wafer can be melted at any desired spot without bringing the heater in contact with the wafer and the surface on which the wax is to be melted. The top of the handle is adapted to receive a die.

Of Interest to Farmers

CLEANER FOR THRESHING MACHINE SCREENS OR RIDDLES.—F. A. BRADSHAW and C. C. WILLIS; care Plains Land Improvement Co., Plains, Mont. The invention has for its object to provide mechanism adapted to be arranged within the threshing machine adjacent



A SECTION OF A THRESHING MACHINE PROVIDED WITH THE CLEANER

the shield or riddle and operated at will to bring it into cleaning position. The cleaner comprises a substantially rectangular frame having cross bars at its center, and a filling of perforated material, as, for instance wire cloth of suitable mesh and weight. The cleaner may be had in inoperative position, and when required is easily operated.

Of General Interest

HAMMOCK.—M. DEMLINGER, 32 Dorchester Ave., Boston, Mass. This invention refers more particularly to a hammock comprising a body and a foldable supporting framework therefor the famework consisting of pairs of hinged uprights and hinged longitudinal members connecting the pairs of uprights. The object is to provide a light and simple foldable frame which can be readily set up, and easily transported.

CUSPIDOR-CASTER.—J. A. HOUSE, Dyer, Tenn. The object of this invention is to provide a support for cuspidors, the support being mounted in such a manner that it will move freely in any direction on caster wheels, and adjustable means being provided for attaching it to a cuspidor of any size and for firmly clamping the cuspidor to the caster.

SHOE HEEL.—T. HAND, 57 West Pine St., Orlando, Fla. The invention has for its object to provide a heel capable of quick and easy attachment to the heel of a shoe, the said heel being of resilient material and provided with a reinforcing plate by means of which it may be attached to the shoe, and wherein the heel body is so arranged, that a maximum of cushioning effect is obtained and maximum of gripping capacity to prevent slipping.

CARTRIDGE CASE.—C. E. SHERMAN, 2619 E. 6th St., Kansas City, Mo. An object of the invention is to provide more particularly a shot cartridge, having a removable and indefinitely re-usable head, thus affording a novel manner of marketing paper cartridges, enabling the distribution of fully loaded paper shells and requiring only the fitting of the re-usable head with a fresh primer to the successive shells as discharged, to make a complete paper cartridge in each instance.

LACING DEVICE.—P. YANTORNY, Paris, France. The object of the invention is to provide a lacing device consisting of a series of elongated crescent shaped flexible loops; the lacing takes place at the exterior of the boot or shoe, the extra thickness of lace at the interior being dispensed with. There are no eyelets for the rain or water to penetrate. In the event of a lace breaking it can be replaced without the necessity of taking off the boot, and the loops being more or less flexible, the wear of the laces is appreciably reduced.

TOWER CONSTRUCTION.—J. B. REID, Box 1642, Tulsa, Okla. This invention has for its object to provide a simple, but efficient skeleton structure, wherein a common means is provided for connecting the pipe sections of the legs and for connecting the cross pipes or rods thereto, the said connections providing also an anchorage for the diagonal braces, rods which are provided with turn buckles permitting the brace to be tightened.

WHEELED GUN CARRIAGE.—E. RIMAILHO, Paris, France. The invention relates to a gun carriage comprising an axle frame, a trail frame pivotally mounted on the axle frame, trail beams, links pivotally connecting the beams to the trail frame so that the beams may form extensions of the trail frame or be connected to the axle frame, means for locking the beams to either the trail frame or the axle frame.

METHOD OF CONSTRUCING COAT FRONTS.—S. GREENWALD, care Greenwald Bros., 47 W. 42d St., New York, N. Y. Among the principal objects which the invention has in view are to prevent the hair incorporated in the stiffening for a coat front from working loose, to prevent the hairs contained in haircloth from working out of the same, and to fix the stiffening member and lining of a coat front, by applying an adhesive material to the margin of a stiffening panel.

Hardware and Tools

DRILL BIT.—F. L. CLEMENTS, JR., 716 Kipling St., Houston, Texas. In drilling for oil by the usual rotary method it is necessary to remove and unscrew the drill stem when changing

SHOWING PARTS IN POSITION FOR PULLING THE DRILL BIT OUT OF THE STEM, AND BEFORE FINAL POSITIONING OF THE DRILL POINTS

the bit for sharpening or the like. The object of the invention is to overcome this objection by providing a method for passing the bit through the drill stem, thereby reducing labor, and wear and tear on the machinery, in displacing and placing new bits.

Heating and Lighting

FOOT OPERATED VALVE.—P. A. RICCIO, 2026 65th St., Brooklyn, N. Y. This invention relates more particularly to valves for radiators such as is commonly employed in buildings for heating purposes and is adapted for use in connection with either steam or hot water, and which is operated entirely by the foot, thus overcoming the necessity of stooping over and turning a hand valve as in general use. A further object is to provide a valve which is released, or locked in closed position by means of a foot operated pin.

Machines and Mechanical Devices

REVERSIBLE COUNTER SHAFT.—N. ARBEITEL, 787 State St., Bridgeport, Conn. An object of this invention is to provide a counter shaft for transmitting power from a line shaft to a machine tool such as a lathe, drill press, milling tool or other machinery. A special purpose is to provide a counter shaft capable of being reversed in direction in order to remove a cutting tool such as a drill from work, and to return the carriage of a milling tool from one end of the machine to the other.

RIVET HOLDING AND TRANSPORTING DEVICE.—A. L. MOORE, SR., 4423 S. Liberty St., New Orleans, La. The invention relates to the distribution of heated rivets in connection with structural steel operations. The main

A VERTICAL SECTION THROUGH THE DEVICE

object is the provision of means whereby rivets in a heated state may be distributed from a central heating point and transported considerable distances, without losing their heat and without danger to nearby workmen.

DRILL.—M. HOFFMAN and P. JOPLING, Rock Island, Ill. The invention has for its object to provide a form of drill head, wherein oppositely arranged longitudinally extending guide ribs are provided for guiding the drillings to the drive worm, said ribs forming continuations of the ribs of the worm and having shoulders butting the ends of the ribs, and wherein a form of bit is provided formed from a plate of metal stamped and bent to shape and so connected with the head that it will be firmly held for cutting movement.

Musical Devices

ATTACHMENT FOR PLAYER PIANOS.—O. E. WALL, Box 648, Honolulu, Territory of Hawaii. The invention relates more particularly to automatic controlling features in lieu of the usual hand controls, the prime object being the provision of note sheet actuated controls so that operation of the controls may be brought about strictly in conformity to the particular piece being played. A further object is the provision of means which may be readily applied to various characters and makers of player pianos, without materially disturbing the automatic playing parts.

Prime Movers and Their Accessories

STEAM TURBINE.—A. BONOM, Central Bldg., Paterson, N. J. Among the objects of the invention are to provide a perfect balancing of the several independent rotors with a single admission port for the steam or other motive fluid, to provide a turbine in which there are no pistons as distinguished from the parts carried by the rotors, to prevent to a substantial degree leakage of steam or other motive fluid by the use of labyrinth packings, and to construct a practical high speed simple, light, true running and efficient turbine.

VALVE LIFTER.—J. H. VONADA, Coburn, Pa. The invention relates to valve spring compressors more particularly designed for facilitating the removal of engine valves. An object is to provide a device of this character whereby the spring for an engine valve which holds the same to its seat, can be readily compressed for the easy removal of a key or pin from the stem of the valve to permit the extracting of the valve from its casing so that said valve or its seat may be conveniently removed.

Railways and Their Accessories

COUPLING HOOK.—T. W. FAULDS, 1304 S. 4th St., Clinton, Ind. An object of the invention is to provide a coupling hook such as used for coupling cars and the like, in which the hook is held by gravity in its holding position, and is so constructed as to prevent disengagement by any ordinary movement to which the parts would be subjected in operation. A further object is to provide a coupling hook which cannot be released when in normal position, but must be moved to an abnormal position.

CAR-TRUCK AND MOUNTING.—B. G. VAN DYKE, JR., 1193 Hamilton Bldg., Detroit, Mich. This invention has for its object the provision of a truck pivotally mounted with respect to the car whereby to facilitate rounding curves and consequently saving wear and tear on the wheel flanges, the truck being equipped with springs which provide resilience and which also tend to prevent lateral motion of the truck under the car body.

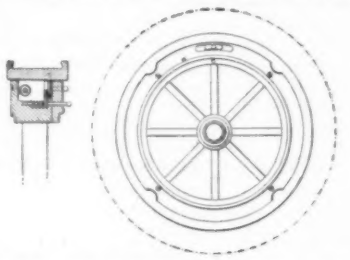
LUBRICATING MECHANISM.—J. W. FREEMAN, address J. R. Davidson, Monticello, Ga. The invention relates more particularly to a means for lubricating the bearings of connecting rods for engines either of the locomotive or stationary type, an object being to provide a construction and mounting for a lubricant feed box which is carried by the rod or other movable member and which is cushioned so as to absorb vibrations. A further object is to provide lubricating mechanism which enables the engineer in his cab to keep it supplied with lubricant.

Pertaining to Vehicles

GEARING FOR GENERATORS AND DISTRIBUTORS.—A. F. WAGNER, 1902 Broadway, New York, N. Y. The invention relates to lighting and igniting devices for internal combustion engines, and has for an object the provision of a construction which is especially adapted for automobile engines, whereby a distributer and generator may be run at different speeds from the same shaft. A further object is to provide a construction which is so arranged as to be quickly applied and removed without disturbing the distributer and its proper action in connection with the engine.

GAS PRODUCER FOR PROPELLING VEHICLES.—D. J. SMITH, London, England. The invention relates to gas producers and apparatus connected therewith for supplying internal combustion engines, the producer being either of the suction or pressure type. The object is to provide a producer of relatively light weight, small size and high efficiency, adapted to supply gas to internal combustion engines used for driving motor vehicles, motor boats, and the like, all the operations being mechanically controlled.

DEMOUNTABLE RIM.—G. KNOWLING, JR. address, S. J. FOOTE, Water St., St. John, Newfoundland. This invention has reference more particularly to means for locking the rim on the wheel body. An object is to provide a simple demountable rim which can be easily and quickly



AN ELEVATION OF A WHEEL PROVIDED WITH THE DEMOUNTABLE RIM, AND A CROSS SECTION

removed from the fixed rim and another detachable rim substituted therefor. A further object is to provide a demountable rim which is equipped with locking wedges normally retained in position by yielding means and which wedges prevent an axial movement of the demountable rim on the wheel body.

Designs

DESIGN FOR A POWDER CONTAINER OR SIMILAR RECEPTACLE.—L. A. WEGENAAR, care Manhattan Can Co., Bush Terminal Bldg., No. 10, Brooklyn, N. Y.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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UNTIL Thaddeus Fairbanks invented the platform scale, weight-measuring instruments had not greatly changed since ancient Babylon. From age-incrusted pictures carved in stone we learn that these instruments in use in Egypt differed little from the one probably used in Abraham's transactions with the sons of Heth, of which we are told the four hundred shekels he paid Ephron for a burial place were weighed out in silver currency.

It remained for an ingenious Yankee hemp dealer and artisan to solve the problem of accurate weighing by means of the platform scale as we now know it. Until his invention appeared in 1830, old-time methods of weighing, by balance or steelyard, were the only ones in use. Little did this Vermont inventor realize how great a revolution he had wrought in the world's trading methods!

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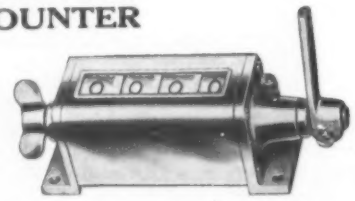
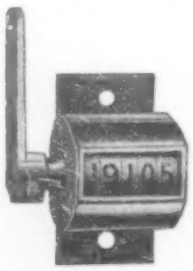
Veeder
COUNTER

The large Set-Back Revolution Counter at right is ½ actual size. The small Revolution Counter below is shown nearly full size.





The Set-Back Revolution Counter above records the output of the larger machines where the revolution of a shaft registers an operation. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, according to purpose. Price, with four figures, as illustrated, $9.00 (subject to discount).

The Small Revolution Counter at left records the output of smaller machines where a shaft-revolution indicates an operation. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines. Will subtract if run backward. Price, $2.00.

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Can Duplex Craft Speed Up Transportation?

(*Continued from page 479*)

the same speed and displacement would be required, and these would represent an increased first cost of fully 60 per cent. In addition to this, there would be a much heavier outlay for upkeep, personnel, insurance, etc. Because the motive power of the pusher-freighter unit is installed at the after end of the twin arrangement, it is possible to provide a very large, roomy and unobstructed hold for the stowage of merchandise on the carrier. For the working of the derricks, the cargo craft is equipped with a small auxiliary steam plant.

For river and canal traffic, and also for runs on sheltered coastal waterways, M. Constan suggests a combination of pushing and towing service which will permit of one steamer to handle at least three barges. These interlock so that they constitute only two units. The benefits would be still greater if a convoy of five instead of three barges were involved—the string in that case forming three duplex sections. The expert says: "Let us consider the case of a pusher of 300 horse-power, capable of making 7½ miles an hour, handling five barges each of 230 tons capacity. On the other hand, imagine five other barges of like carrying capacity being towed by a tug in the normal way and at the same speed. The latter power boat would have to have an engine equipment of 720 horse-power. Therefore, the pusher system would achieve the same end on a motive economy of 50 per cent."

The Ingenuity of the Watchmaker

(*Continued from page 482*)

Every one who has examined the movement of a watch must have wondered at the little holes in the jewels. The same Gilstad devised a novel device for measuring these holes. In the picture, with the cap removed, the tool looks like a thermometer, but protruding from the upper section is what suggests a fine wire. The shadow of this is plainly visible in the picture. Under the glass, however, this apparent wire will be seen to be conical in shape. This tapering member is inserted in the hole of the jewel as far as it will go. The measurement is then taken by pushing down the sliding index-finger, which may be fixed in this position by a small screw until the instrument can be moved into a spot where the reading can conveniently be taken on the scale, which is plainly to be seen.

An operation that few watchmakers attempt is that of enlarging the hole for the roller jewel, in order to insert a larger jewel. This is sometimes done in high-grade watches having three corner roller jewels which play into the slot of the fork and eventually wear out the sides of this slot through friction. This is a very delicate operation, and a New York watchmaker, George Bergleitner, has invented for the purpose a special tool which may be attached to an ordinary lathe. To do the work by hand would not be nearly so accurate, and would moreover be very difficult on account of the hardness of the metal to be drilled through. Mr. Bergleitner has frequently changed the position of the roller jewel, which requires readjustment of the whole watch and consequently a thorough knowledge of horology.

A quaint tool, not used very extensively nowadays, is known as the rounding-up tool on account of its being used for rounding up wheels which, after several years of use, have become "out of round." The tool is also supplied with disk-shaped cutters for increasing the distance between the teeth of the wheels and in this way allowing them to mesh better with their neighboring wheels or pinions. This is rather a large tool and has been used skillfully by watchmakers of the old school, especially in the days when it was not possible to get new parts quickly.

The Automatic Substation from an Economic Standpoint

THE tendency in the development of modern electrical apparatus is to utilize more and more the automatic features which are proving to be important factors in extending its use.

No recent development has created more general interest or possess more economic possibilities than that of the automatic substation.

The automatic substation in simple language consists of a synchronous converter, a bank of transformers and three or more switchboard panels on which are mounted electrically operated switches, relays and instruments. It is really uncanny in what it will do when trolley voltage falls below a predetermined safe value. Without human aid the converter starts up and reaches synchronism and assumes its share of the total load on the line. If the load increases to a point dangerous to the converter it immediately shuts itself down and the line switches all open. If a converter bearing should overheat, instantly a relay operates and the converter shuts itself down. If the load on the line drops to a point where the converter is not required, it automatically comes to rest. It will go through this cycle of starting and stopping just as often as the line conditions make it necessary, it being possible to start up, close all switches, open all switches and stop the converter twice per minute.

Naturally since such power is at instant call without an attendant at the station, certain limitations exist which react to counterbalance the good qualities of automatic switching, but they in no way destroy the great commercial advantages of such switching.

A competent engineer must inspect the apparatus weekly and the station must be cleaned up three or four times a month. One engineer could inspect a great many stations on a regular schedule so this item will add but a trifling labor charge. The cleaning up can be done by ordinary car barn labor.

The original investment will, of course, be greater than for a manually operated station of equal capacity.

The automatic switching is more complicated than hand switching but on close acquaintance it becomes quite simple.

Feeders must be applied with great care to save trolley wires which drop to the ground from annealing.

Since there are no operators to transfer high tension lines in case of trouble these lines may in certain cases have to be arranged for automatic installations. It may be possible to handle this high tension switching by remote control.

The fact that automatic substations require no attendants should itself effect an economy of $2,500 per station, allowing two men per station for hand switching.

The absence of attendants leads directly to a second marked advantage, the elimination of labor difficultiees. This is an important factor under the present disturbed condition of labor generally.

Since the automatic station shuts itself down when power is not required the saving in energy will amount to a considerable item.

By relocating or increasing the number of substations enough feeder copper can be saved on many propositions to pay for a great proportion of the cost of automatic switching.

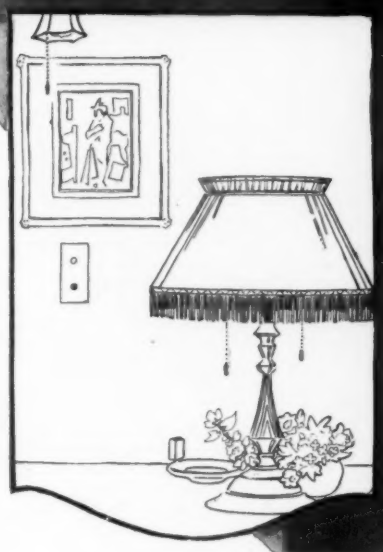
Experience thus far indicates that reliability of operation will be increased. Considering the ability of the best operators that can be secured and the introduction of the ever varying "human element," the automatic switching should prove by far the more reliable method of operation.

Maintenance has been very low in those cases which have been under operation.

Summing up, there is no doubt but what the automatic substation is here to stay and its economic features demand consideration whenever the installation of a new substation is projected.

UNDARK

Radium Luminous Material



"I want that on mine"

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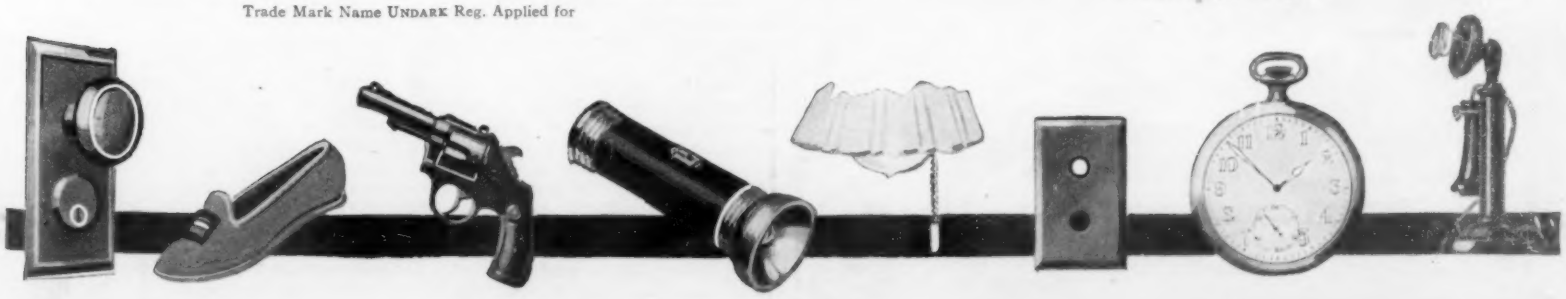
Push-Button Switches	Telephone Mouthpiece
Flip Switches	Fire Extinguishers
Door Bells	Mine Signs
House Numbers	Women's Felt Slippers
Hospital Call Bells	Fish Bait
Ship's Compasses	Theatre Seat Numbers
Locks	Convention Buttons
Safe Combinations	Poison Indicators

Names of the makers of these furnished upon request



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It is also an essential part of the DYNAMOMETER, an instrument that automatically records the speed, drag, track grade and vibration of a locomotive travelling at all speeds.

This unfailing reliability, extending over 36 years, has made Waterman's Ideal Fountain Pen the favorite writing tool throughout the world with men of affairs, scientists, scholars, authors, students, doctors, the clergy, and, in fact, all whose business or social requirements demand personal handwriting.

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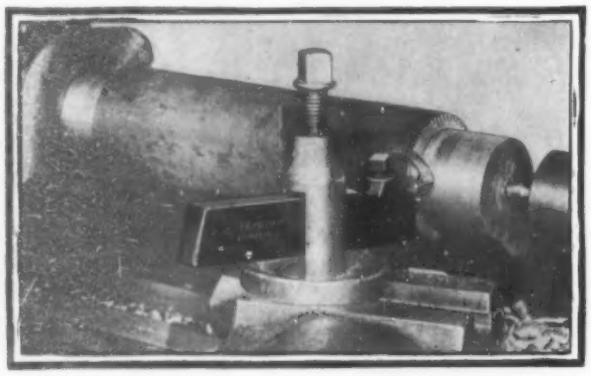

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Williams' Superior Drop-Forged Machinists' Tools

Woods for Posts and Stakes

OUR respect for cedar fence posts and stakes is inherited from the early American colonists. The weakness of many woods when used as posts or stakes is a disposition to rot in the ground. While the exposed part of the post indicates good preservation, the imbedded section may be ready to break at the first heavy strain. In a contest with other woods, cedar easily wins out. A matter not of several years, but of scores, tests the virtues of the cedar for fence post purposes.

But the cedar is not the only wood which will remain long underground without rotting. To go to the Pacific coast for an example, redwood will. In particular, great quantities of redwood have been used for grape stakes. The grape stake is a slighter piece than the fence post, but it demands very definite qualities.

Now it doesn't do to specify simply, "redwood grape stakes," despite the fact that the two varieties of redwood, coast and mountain, are about equal in decay-resisting properties, and both are used for stakes. Environment has created two varieties which in a most important respect are as far apart as the poles. Coast redwood has a strong, straight grain, and it splits in a clear, beautiful way. The wood is tough; it will withstand heavy strain.

Mountain, or Sierra redwood, is brittle. It is hard to split true. The fibers are as weak as the coast varieties are strong; frequently, in splitting, they will snap off sideways. On the split posts shoulders are usually observable, indicating this characteristic.

Horticulturists will say, however, that the difference in quality of grain and fiber is not insurmountable. Both varieties are decay-resisting, and that is the most necessary trait. As for strength, they split out the coast redwood into small pieces, the Sierra variety into much thicker ones. Thus thickness is made to overcome the brittle tendency.

Redwood grape stakes have increased one hundred per cent in price within a few years. The standard price now is ten cents. A parallel increase in the East is observable in bean pole values. There was a time when bean poles cost so little that the wood they were of mattered not very much. Anyway, the poles didn't remain in the ground after harvest. The farmer usually cut what was handiest. The market gardener had his preferences, but price levels left bean poles a less important matter.

Now there are farmers with whom bean poles to be shipped away to market gardeners near cities are a worth-while product. And with the prices obtainable alive with interest, the farmer has discovered a lot of lore on the subject. The fact that bean poles are saplings, usually of quick growth and young, impairs their lasting qualities. Undoubtedly the best bean-pole is made from horn-beam, sometimes called lever-wood.—*J. T. Bartlett.*

Exploiting the Inventor—IV

(Continued from page 484)

upon such a proposition with extreme suspicion, until you are able absolutely to convince yourself that there is no connection between the prospective buyer and the man who will collect the money you are to put out.

Another thing to fight shy of is the scheme that appeals to your local pride. You are a loyal citizen of New Chicago, a thriving town in—well, let us say the state of Washington. An eloquent gentleman comes to town with a remarkable new ball-bearing axle which he is going to manufacture by the tens of thousands, to the everlasting revolution of the automotive industry. He is going to set up his factory on the banks of the river in New Chicago. He himself is a Washingtonian, and the new enterprise will be wholly organized and backed by New Chicagoans. If he can, he makes it appear that the axle is the invention of a New Chicagoan, and calls upon all New Chicagoans to get behind and push, for the everlasting glory of New Chicago. He puts it across with a whoop and a hurrah—everybody get aboard the bandwagon and bring this great new industry to New Chicago. New Chicago will get rich and famous from the money which the factory payroll will bring to it and from the repute which will follow in the wake of the universal adoption of the new axle. So all New Chicago invests—and when the glib stranger has "taken" New Chicago for all he figures it to be worth, he moves on, to cash in on the local pride of some other neighborhood. The moral here is that a proposition which has no better arguments than the fact that all your friends and neighbors are in on it is a pretty weak proposition in 99 and 44/100 per cent of the cases.

Invention is a wonderful faculty of the human mind. To the inventor we owe nine-tenths of the comfort and the joy of modern civilization. But the invention perverted to a stock-selling scheme has been responsible for a great deal of misery. It is the hope of those who have the best interests of the inventor at heart that enough publicity of this character may serve to keep the honest but gullible investor from losing his savings to the magic of the words "wonderful invention." It is to be hoped that the man who has an honest invention will learn from such cases as have been shown up to make an endeavor, in marketing his patent, that it shall not fall into the hands of stock sharks and become the vehicle for swindles rather than for honest manufacture. Thus the opportunities of real inventors, who have real ideas, may be made greater to realize on their brains through the elimination of the grafter and the crook.

Subduing the Boll Weevil

(Continued from page 486)

damage to the cotton plants in turning the machine at the ends of the rows and in avoiding obstructions over the fields. Furthermore the distributing system with its five nozzles is hard to handle in the average cotton field with its frequent obstructions while the labor supply on the ordinary plantation is not skillful enough in handling machinery to properly operate the engine-driven dust spreader.

As the dusting machines are operated at night it is necessary to equip them with artificial lighting systems. For this purpose a light using a compressed carbide cake has been found to be very satisfactory as it furnishes plenty of illumination, is automatic in control and comparatively simple to operate. An added feature of this outfit is a reflector especially designed to meet the requirements of illuminating cotton fields. As a rule, gasoline lanterns have proved impractical because the mantles are too fragile while compressed acetylene gas systems—although efficient—have proved too costly for use on the average plantation.

It is anticipated that many of the rather crude systems of spreading the poison for the eradication of the boll weevil now in use will be improved upon in the near future. The fact of chief interest at this writing is that an efficient method of controlling the pest has been discovered. Due to the fact that poison material which contains over .75 of 1 per cent of water soluble arsenic is liable to burn and seriously damage the cotton plants, it is of fundamental importance that the southern planters use poison dust which is well within this limit in arsenic content. Uncle Sam has recruited all his resources to aid in educating the cotton planters concerning this efficient control and its intelligent application. Any farmer who desires assistance of any nature relating to the control of the boll weevil or the testing of calcium arsenate should correspond with the Delta Laboratory, Tallulah, La., which is the official organ of the Federal Government in the cotton cropping section.

LEGAL NOTICES

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to **Patents, Trade Marks, Foreign Patents, etc.**

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contains Patent Office Notes. Decisions of interest to inventors—and particulars of recently patented inventions.

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The House on the Hill with Front Door in the Valley

(Continued from page 487)

mens were broken up and lost because the workmen did not appreciate the significance of the discovery and the museum authorities were not expecting it. The Southwest conchology collection is one of the most valuable extant, comprising more than 11,000 varieties and 70,000 specimens.

The mouth of the shaft is at the side of the huge entrance vestibule midway in front of the building, and the elevator entrance thus is right opposite the former main doorway. The elevator housing, for the heavy machinery, is built up nearly to the height of the vestibule. A concrete spiral stairway winding about an open shaft reaches the length of the tower.

Aside from its utility the novel subway is specially appealing and notable because of the duplication and adaptation of Mayan architecture, particularly in its ornamentation. No similar undertaking can be accredited to moderns. The handiwork of the supreme aboriginal intellectual race of these western continents is being reproduced with absolute archeological accuracy. It possesses distinctive dignity and beauty and will have true educational value. Perhaps the most magnificent creation of the Maya was the Casa de Monjas, a nunnery in Chicen-Itza, Yucatan, of which much still stands. Its ornate facade furnishes the motif for the Southwest tunnel portal, now being embellished. The principal design embodies six serpent forms with large heads over and at the sides of the entrance, and already in evidence. A little imagination is essential to bring them out clearly. Geometrical designs also will be employed in the facade and elsewhere. The more comprehensive showing will be made in the waitingroom and subway, with 4,000 square feet of side walls and 3,000 of ceilings to be treated.

In the subway are fourteen niches, seven in either wall, each 3½ feet wide and 3 deep and high, in which will be placed habitat groups illustrative of the homes, costumes and lives of the aborigines of the Southwest. Of these only one, that of the Hopi, is completed; for each requires many weeks, or even months. Every detail is worked out with painstaking fidelity. The habitations are constructed of the same materials and in the same way as by the original builders.

The mysterious Maya builded superbly in their day, fifteen hundred to a thousand years ago. The Spaniards came far to conquer and ruthlessly tear down and wipe out their civilization. The Southwest Museum is a splendid example of the medieval Spanish. This combination of the architecture of the two peoples, that of the vanquished and vanished serving as a stately approach to that of the destroyers, seems oddly appropriate, with a touch of poetic justice and a hint of irony. It will be an eloquent earnest to the coming centuries that genuine achievement is not forgotten but perpetuated.

Annealing with Gas

(Continued from page 488)

building a large annealing-room equipment. The material to be annealed was in the form of small pieces, and under the old method it required that they should be placed in trays and lifted in and out of a wood-fired furnace.

A conveyor-type furnace heated with gas was built and placed in operation. The conveyor was made up of narrow cast-iron plates turned up on each end, forming a continuous pan through the furnace. The work was then placed on the conveyor by shovels or dumped from boxes and the conveyor timed so that when it reached the other end the material was properly heated. Discharging from the furnace conveyor into a quenching bath out of which another conveyor ran, the work was conveyed to the "pick-

St. Louis
Invites Sixteen Industries

A GROUP of St. Louis business men smoked and chatted at their club. The conversation drifted to the one hundred new industries and fifteen million square feet of factory space built in St. Louis during the last two years; the General Motors Company's new $5,000,000 plant; the United Drug Company's $3,000,000 factory, and other new industries representing many millions of dollars and employing more than 14,000 workers.

As they talked, these keen business men began to realize the need of other types of industries to fully round out St. Louis as a well balanced trade center, ready to supply anything that might be called for over its industrial counter. A trade analysis convinced them that a wide market exists in St. Louis for many products not now made in St. Louis.

"The market is here, so why not bring factories here to make the goods?" asked one.

That started something. At a later meeting each man had a list of articles needed in St. Louis territory but bought elsewhere. "We need shoe findings," said a shoe manufacturer. "There's an immense demand here for steel and copper wire," said another. "Machine tools and drop forgings," chanted a third. The final count showed sixteen distinct types of industries needed to fill St. Louis' industrial gaps.

A banker, who had listened attentively, suddenly struck home with a proposition:

"Let's go after those sixteen industries we need. I'll contribute to an advertising fund to bring them to St. Louis. Are you with me?" Within five minutes the fund was well up into the thousands. The municipality became interested and the City of St. Louis duplicated the business men's subscriptions, dollar for dollar.

This advertisement opens the campaign set in motion by those men of vim and vision. Here are the sixteen new lines of industry sought:

Shoe laces and findings
Cotton spinning and textile mills
Dye stuffs
Steel and copper wire
Machine tools and tool machinery
Automobile accessories and parts
Drop forge plants
Tanneries and leather products
Malleable iron castings
Farm implements
Rubber products
Screw machine products
Locomotive works
Blast furnaces
Cork products
Small hardware

Which of the above interests you? Would a Mid-West factory help solve your production and distribution problems? A letter will bring you details. Address it to

Director, New Industries Bureau

St. Louis Chamber of Commerce
St. Louis, U. S. A.

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W. L. Douglas shoes are for sale by over 9000 shoe dealers besides our own stores. If your local dealer cannot supply you, take no other make. Order direct from the factory. Send for booklet telling how to order shoes by mail, postage free.

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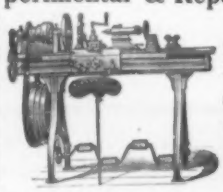

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ling" solution without handling. Not only did this method prove to be more economical in the cost of fuel and labor, but it was also soon discovered that less pickling solution was required due to less scale on the material.

The application of gas to annealing is not confined to metals. We illustrate a portion of a group of five bottle-annealing lehrs at a plant in Tennessee. Each lehr or furnace has an inside dimension of 5 feet by 65 feet in length. The capacity is 9000 bottles per lehr per day. As fast as the bottles are "blown" they are placed in steel pans which project in front of the furnace. A conveyor system carries them to the extreme end of the furnace where they are discharged at atmosphere temperature. In the heated end of the lehr the temperature is maintained at 1100 degrees Fahrenheit. The gas piping and control valves will be noticed immediately over each furnace. The furnaces are arranged in a way that permits the exact temperature of each to be noted.

Manufacturers are today as much interested in production methods as they are in production costs, because efficient methods mean reduced costs, and in the last analysis, it is not a question of the price of fuel per ton, gallon or cubic foot, but the ultimate cost per unit of product. Gas fuel saves two-thirds of the factory floor space; in most cases considerable labor; ensures absolute reliability and uniformity of temperature; eliminates smoke and excessive heat, and saves fuel by a more efficient application.

What Europe Is Doing in Aviation—Americans, Please Take Notice!

(Continued from page 489)

than any other country with this type of direct-lift machine that is so urgently needed, yet her poorer inventors who are capable of doing quite as brilliant work as Dr. Peter Cooper Hewitt and Prof. Crocker, are unable to continue their work because of no Government encouragement. By developing a helicopter mail machine, the Post Office Department would dispense with millions needed to purchase landing fields and would effect as great a saving, no doubt, as Handley-Page appears to have done with the airplane. It would also be invaluable in war, as the French realize.

In view of the fact that the inventor claims 110 miles an hour for five hours with a two-man biplane having but a 25-h.p. motor—a motorcycle engine—it is interesting to speculate on what speed will be reached in the Bennett Cup Race in France next September. A 300-h.p. Nieuport biplane has made 171.4 miles an hour and 192 on one leg of the course. A speed of 300 miles an hour appears now to be possible. If the French win this race, they will retain the Cup for all time, so it is to be hoped some sportsman will back America to win by putting up $100,000 or more to enable her aeronautic engineers and designers to build the speediest plane in the world. The SCIENTIFIC AMERICAN Racer which we illustrated a decade ago, will give them a good basis to work from, and we shall be glad to furnish all its details and render every assistance in our power.

The Backbone of Naval Power

(Continued from page 490)

cording to the tactical doctrines of the present day, and because she is already exerting a marked influence on naval design the world over.

The "Hood," we recall, was originally to have been laid down in 1915, at which date the British Fleet was none too well supplied with battle-cruisers, and Germany was known to be speeding up the completion of "Derfflinger," "Lützow," and "Hindenburg." But since every large building slip in the United Kingdom was then occupied, the contract could not be placed until late in 1916. As it happened the delay was a blessing in disguise, for meanwhile the Battle of Jutland had been fought, and the experience of that engagement was promptly embodied in a revised design. The original plans of the "Hood" contemplated a vessel of 36,300, but the subsequent modifications involved an increase of nearly 5,000 tons in displacement and of three feet in draught. The dimensions and armament were but little altered, but very considerable improvements were made in the protection against gunfire. A hitherto unpublished feature of the "Hood" is the tremendous weight monopolized by her armor-plate and sub-surface protection, amounting in all to some 13,800 tons, the actual percentage being 33.5 of the total displacement. It is possible that this percentage may be equaled, perhaps even surpassed, in the "U. S. S. Massachusetts," but for the time being the "Hood" is undoubtedly the "stiffest" ship afloat. The large increment of weight due to thicker armor necessitated a slight sacrifice of speed. Thus in place of 32 knots originally provided for, the "Hood," as completed, has a speed of 31 knots at load draught and 30-30½ in complete fighting trim. Notwithstanding the additional weight, calculations and model experiments showed the stability conditions to be favorable, while a very satisfactory metacentric height was maintained.

The propelling machinery consists of geared turbines aggregating 144,000 horsepower—36,000 horse-power on each of the four shafts. There are three separate engine rooms: the forward room containing two independent turbine sets and gearing for the wing shafts, and the middle and after rooms one independent set for each of the two inner shafts. The twenty-four boilers, all oil-fired, are disposed in four compartments. The maximum supply of fuel is 4,000 tons, the capacity at load draught being 1,200 tons.

On paper the "Hood's" armament shows no advance over that of the Queen Elizabeth, a ship laid down nearly eight years ago. Actually, however, it is of considerably greater power. The 15-in. gun mounted in the new battle-cruiser is a new model, 45 calibers long, as compared with 42 calibers in the preceding model, and with increased muzzle velocity and energy. No official ballistics have been published, but the new gun is credited with the following data: Weight, 98½ tons; weight of projectile, 1,950 pounds; muzzle velocity, 2,800 foot-seconds; muzzle energy, 86,700 foot-tons. The mountings allow of an elevation of 30 degrees, the range at this elevation being calculated at approximately 38,000 yards. Various improvements in the loading gear have increased the rate of fire very materially. Under battle conditions the "Hood" should be capable of firing a full salvo of eight guns every 35 seconds. The turret port-plates are 15 inches thick, the turret sides are 12 to 11 inches, and the roof is stout enough to withstand plunging fire from the heaviest calibers. As, moreover, the roof is almost flat, shells descending at a steep angle would probably be deflected. The gunnery control tower (G.C.T.), built above the conning-tower, is furnished with a 30-foot base rangefinder in an armored revolving cupola, while each turret is provided with a similar instrument built into the crown and protected by strong armor. Other rangefinders are mounted in various parts of the ship. The advantage of this duplication is that even though both the foretop and the main control were disabled, each turret would still be able to use its guns with effect at the maximum range of visibility possible.

Criticisms have been raised in regard to the secondary armament, on the score of inadequate protection. Of the twelve 5.5-inch rapid-fire guns, ten are mounted in an open battery on the forecastle deck, the remaining two being situated at shelter-deck level. None of these guns has any protection beyond a 1-in. shield, and

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it is contended that the entire armament on which the ship has to rely for repelling torpedo attack might be wiped out by the first salvos of high-explosive shell. The 5.5-inch is one of the new marks introduced into the British Navy during the war. Weighing only 6 ton 4 cwt., it fires an 82-pound projectile with a muzzle velocity of 2,950 foot-seconds, and at extreme elevation will range up to 12,000 yards. With a seasoned crew this gun can be worked at the rate of twelve aimed rounds per minute. Four 4-inch anti-aircraft guns are mounted on the shelter-deck aft, and provided with a special control position. There are six 21-inch torpedo tubes, including four above water.

A point to be noted is the remarkably extensive distribution of the armor. The main belt, 12 inches thick, runs the whole length of the side between "A" and "Y" turrets, a total distance of 562 feet, at a uniform depth of 9 feet 6 inches. Surmounting the main belt is a strake of 7-inch armor reaching to the upper deck, and above this again is a layer of 5-inch armor as high as the forecastle deck. All the vertical armor slopes outward at a sharp angle, thus increasing the difficulty of penetration for shells fired at any trajectory. Behind the armor there is plating from 2 inches to 1½ inches thick, giving greatly increased strength to the whole structure. According to the Chief Constructor, the anti-torpedo defense consists of the now well-known "bulge," with an outer compartment of air and an inner one specially strengthened by the necessary division bulk-heads.

Sir Eustace d'Eyncourt reminds us that no ship provided with the original or the later form of bulge was sunk, nor even seriously damaged, by torpedo attack during the war, nor was there any loss of life from torpedo explosion in ships so fitted.

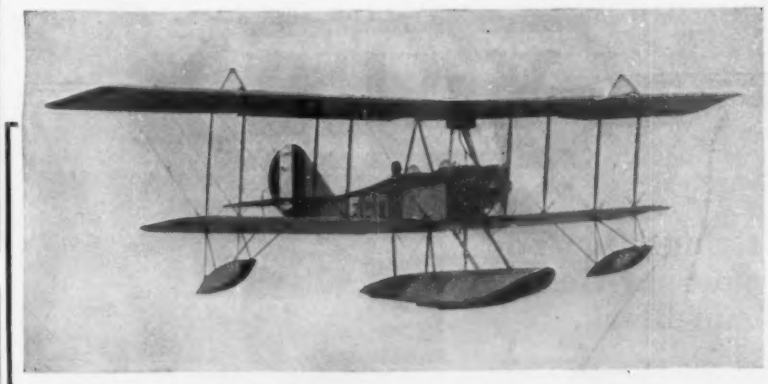
The "Hood" has a complete outfit of auxiliary machinery, including a very elaborate plant of submersible pumps, which saved many a ship from foundering in the war. There are four steering positions in the ship, but the usual hand-steering gear is dispensed with, war experience having failed to justify its retention. Great improvements have been made in the living accommodations on board. It is stated that the berthing, cooking and sanitary arrangements are not inferior to those of the latest American warships, and that, as British officers know, is saying a good deal. As regards the general design, the Chief Constructor cites the "Hood" as an example of what may be achieved by substantially increasing the displacement of capital ships. With the gun-power and armor protection of a first-class battleship, and with excellent defense against underwater explosions, she combines the speed of the fastest battle-cruisers. It would, of course, have been impossible to embody all these qualities to the same extent in a ship of smaller displacement. The total cost of the "Hood," viz.: £6,025,000, works out at £145 per ton, an increase of only 60 per cent above the pre-war average.

The Fuel Case of Coke vs. Coal

(*Continued from page 491*)

required by all railroads and steamship companies, which make a laboratory test on every lot of coal they purchase, then the superiority of the anthracite would at once be apparent and demonstrated.

For use in heating residences and offices where stoves or furnaces are utilized, there has recently been put on the market several sizes of coke suitable for use in even the smallest stove. This small sized coke is now available in the egg, stove and nut varieties, corresponding to the various standard sizes of hard coal, with which householders are acquainted. A few words as to the use of coke in small stoves and furnaces may not be amiss.



Navy Sale of Seaplanes

A large quantity of seaplanes, spare parts and accessories are offered for sale by the NAVY at fixed prices. This is an unusual opportunity and should be given careful consideration by everyone who is interested in aviation

PLANES ARE NEW—NEVER HAVE BEEN FLOWN

and most of them are still crated as received from the makers. They have been well taken care of and are in excellent condition. We advise immediate action, as orders will be accepted and filled in the order in which deposits are received.

HS-2-L TYPE FLYING BOATS—pusher biplane—one Liberty engine of 300 H.P.—wing spread (Upper plane) 74 ft., total supporting surface 803 sq. ft.—maximum speed 85 miles per hr.
Sale price.....$6,160

MODEL 40 FLYING BOATS—pusher biplane—one Curtiss 100 H.P. engine—wing spread approx. 48 ft.—total area 504 sq. ft.—maximum speed of 70 miles per hr.
Sale price.....$4,000

CURTISS GNOME SPEED SCOUTS—complete with Gnome engine installed. Never flown. Packed in original cases.
Sale price.....$2,000

H-16 TYPE FLYING BOATS—tractor biplane—two Liberty engines of 330 H.P. each—wing spread 95 ft.—total wing surface 1,164 sq. ft.—maximum speed 95 miles per hr.
Sale price.....$11,053

AEROMARINE TYPE 39-B SEAPLANE (pictured above)—tractor biplane—Curtiss 100 H.P. engine—wing spread 47 ft.—total area 494 sq. ft.—maximum speed 72 miles per hr.
Sale price.....$3,000

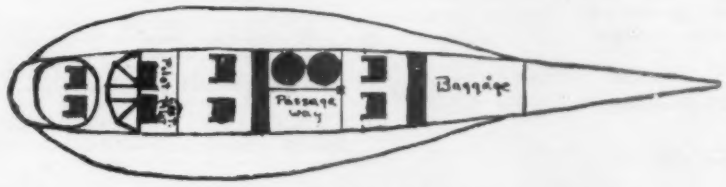
This we consider our best buy. Endorsed by NAVY flyers as the safest and most easily operated seaplane. A manufacturer is marketing a set of wheels and tail skid which, substituted for the pontoon, converts this into a successful land plane.

F-5-L TYPE FLYING BOATS—essentially same as H-16 (lot 2) but larger—wing spread 104 ft.—total area 1,397 sq. ft.—maximum speed of 87 miles per hr.
Sale price.....$12,400

BOEING SEAPLANES—tractor biplane one Hall-Scott 100 H.P. engine—wing spread 44 ft.—total wing area 495 sq. ft.—maximum speed of 73 miles per hr.
Sale price.....$2,000

TYPE "R" KITE BALLOONS—Used for observation and instruction purposes. Towed by vessels and also flown from land.
Sale price.....$2,500

Those who follow aerial affairs closely, no doubt noticed a recent newspaper item which told of a record breaking flight from Miami, Fla., to Bemini, Bahama Islands, by a seaplane, carrying sixteen and baggage. The plane making this record was a type H-16 flying boat (lot 2) purchased from the NAVY and was originally designed to carry four persons. The sketch shows how it was converted to carry SIXTEEN PERSONS AND BAGGAGE at a cost of about $1,000 for the necessary alterations. You can do the same.



5% OF PURCHASE PRICE BUYS A PLANE

Just send to the Bureau of Supplies and Accounts, Navy Department, 5 per cent of the amount of your order, with your order, and the goods are yours, subject, of course, to prior sale. This deposit can be by certified check or money order drawn to the order of the Paymaster General of the Navy, or the bond of a surety company acceptable as sureties on Federal Bonds. The balance shall be paid within 30 days after acceptance of your order.

ENGINES AND SPARE PARTS

In addition to the planes the NAVY is offering a number of sets of spare parts, at fixed prices, which can be purchased with or without a plane. ENGINES, new and used, are offered in an astonishing assortment and at prices equally astonishing. The list includes: RENAULT, HALL-SCOTT, CURTISS V-2, ISOTTA-FRASCHINI, STURTEVANT, CURTISS OX AND OXX, GNOME, FIAT and the LIBERTY. The prices range from $175 to $2,000 according to make and condition.

Order from this Announcement and Avoid Disappointment

Several lots included in the sale at the start are completely sold out, several times as many orders being received as there were planes for sale. Orders will be attended to in rotation as they come in, so we advise ordering from the descriptions given above. But for those who desire additional information the NAVY has prepared a beatifully illustrated catalogue which will be sent free on request to the

Bureau of Supplies and Accounts, United States Navy
Washington, D. C.

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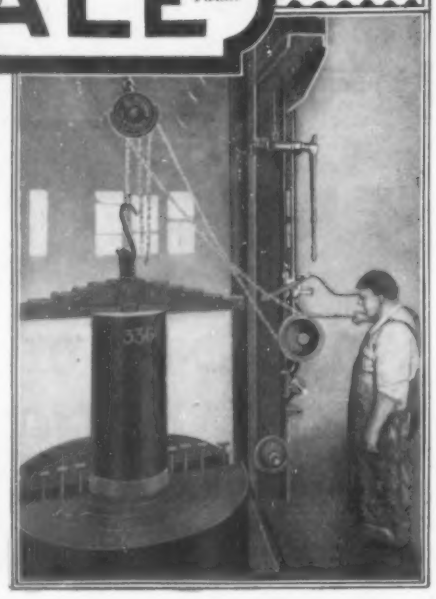

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Due to the free-burning qualities of coke which, by the way, has to be ignited at the start, either from a coal fire or else a good wood fire, the heat produced is very intense and even, and if the large coke is used in an ordinary stove such as a kitchen range, it is liable to burn out the fire-box and warp the top of the stove. However, with the small sized coke, as mentioned above, this will not be the case. Where the nut or stove coke is not available, a "stunt" which has been used with considerable satisfaction in burning coke of standard size, is to break it up to about half its size, and mix it with coal, about half and half.

As already mentioned, the coke does not give quite as much heat per ton as high grade anthracite coal; but in many instances the average grade coke is available at a lower cost per ton than high grade anthracite, and as a special inducement some dealers give a few hundred pounds extra per ton of coke. In this case, the purchaser of a ton of coke will realize about the same efficiency in total heat units as if he had purchased a ton of anthracite.

Coke weighs about 28 pounds per cubic foot for standard size, while anthracite coal weighs 50 pounds per cubic foot. It will therefore be seen that a ton of coke will require almost twice the volume or cubic feet of storage space that a ton of anthracite coal requires.

The Steamship Pier Problem

(Continued from page 493)

425 feet to 509 feet. Now this comparison shows that as compared with the older facilities of New York, there is a distinct advance in the Stapleton development, just as that development is, in respect to pier width, far below the standard of other leading American and European ports.

Our New Piers a Compromise

On the face of these comparisons, it would look as though the Dock Department felt itself to be under the necessity of making some sort of a compromise between the lighterage system of freight handling at New York and the less costly and more convenient system of railhead delivery at other leading ports. This, indeed, is the fact; for we are informed that the width and other elements of the Stapleton piers were not imposed arbitrarily by the Department, but were determined at a meeting at which those steamship companies who were prospective lessees and those who have since leased the piers, were present by invitation, and at which they stated what kind of a pier they wished to have built for their use under conditions which now exist and must necessarily exist for some years to come; or until a belt-line system completely encircling the harbor has been built.

It is certainly very significant that both the Hamburg American and the North German Lloyd companies, which are served at their European ports by splendid modern terminal facilities (broad piers, gantry cranes, et cetera) in building their piers some twenty-five years ago at Hoboken and in accepting a later lease in Brooklyn, should have adopted the narrow pier that is customary at this port. Evidently, they realized that the absence of adequate railway facilities and the existing lighterage system necessitated the construction of piers of that kind.

New York's Great Handicap

The moral then, of the whole question is that, fundamentally, the port of New York is retarded by the lack of proper railroad facilities. There are plenty of railroads running into New York, but they are not interrelated. There is no provision, or very little, for the swinging over of freight from one railroad to another, or to a great belt-line system sweeping around the whole of the port from the Highlands to Jamaica Bay. Not a moment should be lost by the public authorities in taking up this most vital question; finding the best solution; and pushing the adopted plans through to completion with the united effort of this great city behind them.

Turning to the cross-sections of the three types of pier which we herewith publish, the plan of the Dock Department calling for 209-foot piers, with two-storied piersheds and gantry cranes, is by far the best. These piers will have gantry cranes with two tracks on each side of the shed, together with powerful elevators for the transfer of trucks to the upper floor.

On the other hand, we think that Commissioner Hulbert would be wise to follow the old Latin proverb and "make haste slowly" in the matter of building piers only 125 and 130 feet in width. Fortunately, the ample slip space of 300 feet provided by the Department affords room for enlargement of the pier width, and we cannot but feel that, in view of the inevitable ultimate substitution of the railroad for the lighter, it would be wise to provide the additional track space afforded by wider piers.

The Photo-Engraver at Work

(Continued from page 493)

but geometrically a negative; to cure this by interposing a second contact printing, the presswork will give us a geometric positive but an optical negative. We could get away from this by turning the glass plate upside down to make the contact print, but this would not do—the contact print would fail of being a contact print by the thickness of the glass, introducing distortion and other faults. So the engraver finds the answer by backing the film up as it stands on the glass, with rubber and collodion, until he has given it sufficient body so that it may be stripped off the glass and remounted, reversed, on another glass. Then the lights and darks and the rights and lefts come out even.

The contact print from this stripped negative is made on a sheet of copper. The whole treatment of the glass negative during development has been such as to accentuate the dots in terms of which the image stands delineated. The aim shifts in the developing of the copper print, the object being now to make the dots acid-resistant. This turns out to be a simple problem in elementary chemistry—the dots are bound to be chemically distinct from the spaces between anyhow, and they are easily enough made impervious to an acid that attacks copper. The developed copper plate is then immersed in an etching bath of such an acid, and the points stand up while the spaces are eaten away. We then have the original represented not merely by a pattern of dots, but by a pattern of dots in relief. If we ink this and print from it, or if we make an electrotype from it and print from this, the ink stands on our paper in a pattern of dots which the eye sees as a more or less perfect representation of the original. The reader who did not know that this was the way a half-tone worked can verify it by looking at one through a magnifying glass, when he will see the dots very distinctly.

Our cover drawing, it will be seen, represents the first stage of this complicated operation, wherein the camera-man is standing, watch in one hand and lens-cap in the other, awaiting the proper moment to bring the exposure to a close. He will then in all probability remove the "stop" which he has been using, insert in its place one of those lying on the table in front of him, and expose the plate again, in order to do better justice to the highlights or the shadows which he knows will not show up well through a stop of the size first used. Sometimes a careful worker with a very particular job will thus expose a plate with four stops before he is satisfied that he has done justice to a very fine original.